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he Society is not responsible, as a body, for the facts and opinions advanced in the papers pub- shed by it. Editorials are by the Editor-in-Chief unless otherwise indicated and do not necessarily represent the opinion of the Society as a whole.

EDITORIAL

A Century of Wood Preservation in the United States

THE preservative treatment of wood is an ancient art. It was known to the early Greeks and Romans. To ıeet his growing needs man has sought etter and more effective wood preservaives for centuries. Late in the 18th and arly in the 19th century, the use of zinc hloride and of coal tar creosote was roposed. Today, these preservatives are till the most widely used.

Wood preservation in the United States egan in 1838 when the North Central ailroad of Maryland, now part of the 'ennsylvania System, erected a plant to eat ties with a mercuric bichloride soluon. Ten years later the first commercial 'ood preserving plant using alternately ıercuric bichloride and zinc chloride was uilt at Lowell, Massachusetts. From ıese small beginnings, an industry has eveloped which has made an important ontribution to forest conservation in merica.

The history of the wood-preserving inustry is of outstanding interest. Strange- enough, wood preserving methods actully had become highly efficient and efctive before the nature of wood decay as known, and even before the theory of pontaneous generation of life was finally iscarded.

It is true, of course, that as a result of is researches the eminent Italian scholar Francesco Redi concluded that the supposed appearance of life where life previously had not existed was due to the introduction of foreign living material. It is also true that W. Durham in his *Physico-Therapy* published in 1713 expressed the opinion that spontaneous geneation "is a doctrine now so generally exploded that I shall not undertake to disprove it." Yet it must not be supposed that the views of Redi and Durham were generally accepted even among men of science. Not until about the middle of the last century was it demonstrated beyond the possibility of doubt that thoroughly sterilized infusions never developed living organisms unless such organisms were introduced. Furthermore, it was not until 1874 that Robert Hartig disproved the theory of spontaneous generation of fungi in wood and correctly interpreted the true relations of fungi to the decay of wood.

During the past twenty-five or thirty years, a large amount of research has been done to determine the mechanism of the toxic action of various wood preservatives and antiseptics, and to develop the most effective treatments; but coal-tar creosote and zinc chloride still remain the standard wood preservatives despite the fact that their use for this purpose was proposed long before the biological nature of wood decay was known. In the

recent past, the art of wood preservation developed rapidly, partly because of fundamental research, and today, wood preservative methods are very closely associated with and dependent upon scientific research and control. Much of the credit for this research must go to the U. S. Forest Products Laboratory. Thus the Forest Products Laboratory has participated, somewhat indirectly to be sure, in one of the most significant forest conservation programs yet developed in America. For this and other reasons it must be regarded as an effective federal forest conservation agency.

The increase in the use of wood preservative treatments by American railroads during the past twenty-five years is truly amazing. Although the Baltimore and Ohio Railroad and the New York Central Railroad used some mercuric bichloride treated ties as early as 1842 and 1849 respectively, and although the Chicago, Rock Island, and Pacific Railroad treated bridge timbers as early as 1860, wood preserving methods were not generally adopted by the American railroads until about the turn of the century. Today practically every railroad in America is using preserved wood on an ever expanding scale.

During 1936, the last year for which figures are available, over 222 million cubic feet of wood were treated. Included in this volume were almost 38 million cross ties. In 1927, over 345 million cubic feet of wood were given preservative treatment, including some 74 million cross ties. The increase in growth of the use of preserved ties by American railways is indicated by the fact that about 50 per cent of the total tie renewals in 1923 were preserved ties, whereas in 1935, 75 per cent of the renewals were preserved ties. The decrease in tie consumption by American railways is indicated by the fact that cross tie renewals per mile of track fell from 261 for the five year period ending 1915, to 180 for the five year period ending in 1929, and to about 121 in 1937.

It is impossible to give an average figure for the increased life or service of treated wood products. However, an estimated increase in life of from two to three times would appear to be highly conservative. Thus, because of the wood-preserving industry, the annual drain on American forests has been reduced by many hundred million board feet without reducing in any way the services rendered society by forest products. If all the wood that could be treated economically were given preservative treatment, the annual drain on American forests probably could be still further reduced by at least several billion board feet.

When the use of treated lumber was first suggested, and for many years thereafter, the railroads and other wood using industries of England and America showed considerable circumspection in their interest in wood preservation. Evidence of this is shown by the fact that in 1884 Sir S. B. Boulton, after thirty-five years effort to promote the wider use of wood preservative methods, concluded his address to the Institution of Civil Engineers in London as follows:

"The treatment of timber . . . has been acknowledged . . . to have been useful to the art of constructive engineering. It may be made even more useful in the future than it has in the past. All that the advocates for its still more extended use can desire to claim will be, that their methods and investigations may be seriously examined. . . ."

Clearly, Sir Boulton had boundless faith in the efficacy and economy of adequate wood preservative methods. He must have realized that if the wood using industries seriously considered these methods they could not ignore them for very long. Sir Boulton's faith was based on experience, on knowledge, and on demonstrated facts. And he lived to see his faith become reality!

BLISTER RUST SUSCEPTIBILITY STUDIES OF NATURALLY POLLINATED SEEDLINGS OF THE IMMUNE VIKING CURRANT

By GLENN GARDNER HAHN[1]

U. S. Bureau of Plant Industry

Currants and gooseberries are known to be susceptible in general to white pine blister rust (*Cronartium ribicola* Fischer). Within recent years, however, two red currant garden varieties have been investigated extensively and proved to be immune. In Germany, Tubeuf at Munich has proved the variety Rote Holländische to be immune from blister rust over a period of five years, 1928 to 1932. For a longer period, 1928 to 1937, the writer has demonstrated a related variety, the Viking, to be also immune from blister rust in Europe and North America. Seedlings of Viking propagated from seed collected from naturally pollinated bushes growing both where the possibility of cross-pollination with susceptible red currants was not excluded and where such cross-pollination seemed unlikely, produced a very large percentage of rust-immune plants and only a comparatively small percentage of susceptibles. The majority of the latter were weaklings. Among those showing vigorous growth, two were highly susceptible whereas the remainder were highly resistant to rust. To determine whether these susceptibles are fertile or sterile needs further investigation.

MONG the large number of horticultural varieties of the red and white garden currants artificially tested h here and abroad, only a few have n found to be resistant to white pine ster rust (4, 9, 10). No garden varis had been demonstrated to be rust- until Tubeuf (10, 11, 12) reported immunity of the Rote Holländische rant, and the writer (3, 5, 6) that of fruitful and commonly cultivated Vik- (syn. Rød Hollandsk Druerips) red rant from Norway. The immune Vik- is very probably closely related to, l may be identical with, the Rote Hol- dische of Tubeuf.

/iking was given rigorous testing for nunity from blister rust both artificially ler controlled conditions in the greenise (3, 5) and naturally in the field ere it was planted near to, or in the lst of, northern white pine (*Pinus bus* L.) and western white pine (*Pinus nticola* Dougl.) infected with *Cronarn ribicola* Fischer (6). As long as the rust-immune Norwegian currant, distinguishable from the common susceptible garden varieties by the shape of the foliage on its new shoots, is propagated from cuttings, the rust-immune Viking will be perpetuated. However, the possibility of susceptible seedlings originating from Viking, growing in localities where it could interbreed with susceptible garden currants, or in localities considerably removed from these, and where only self-fertilization or intercrossing between different Viking bushes would take place, needed careful investigation. In white-pine-blister-rust-control areas, the growing of Viking might result in the distribution of susceptible seedlings and in the establishment of susceptible plants within these areas in increasing numbers (6, p. 873).

Artificial inoculation studies were made from 1933 to 1937 with naturally pollinated seedlings propagated from Viking seed collected from plants growing in the two types of localities described above, to

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ascertain their resistance from, or susceptibility to, blister rust. The results of this investigation are given in this paper.

Probable Parentage of Viking

According to Paul Stedje, horticulturist, Norway State Fruit Experiment Station, Hermansverk, Sogn, from whom the writer obtained his original Viking stock for testing (3), the variety widely grown in Norway for many years because of its productiveness, is most like the rust-resistant, red currant Prince Albert (4, 9). The latter variety is regarded by Berger (1), in his taxonomic treatment of currants and gooseberries, as a form of the artificially produced fruitful hybrid species, *Ribes pallidum* Otto and Dietrich, orginated by crossing two species of the subgenus Ribesia, *R. petraeum* Wulf.×*R. rubrum* L.

In the Ribes collection maintained at the Arnold Arboretum, Harvard University, the writer had opportunity to examine specimens of the European species *Ribes petraeum*, together with specimens of the hybrid species, *R. pallidum*, and a related hybrid species, *Ribes holosericeum* Otto and Dietrich (*petraeum caucasicum* Jancz.×*rubrum*). In their general shape, the foliage of the new shoots of all of these showed *petraeum* characteristics, i.e., the leaves showed three prominently pointed lobes, the lateral ones often unequal in size, one frequently being the larger. This leaf character, which has been illustrated for Viking in a recent publication (5, pl. 1) is very pronounced in both the Norwegian currant and the Arnold Arboretum specimen of *Ribes pallidum* grown from seed obtained in 1[...] from the Royal Botanic Garden, Ed[...]burgh, Scotland. In the case of both [...] Viking and this seedling of the hyb[...] species *pallidum*, which has produce[...] vigorously growing bush, the uneq[...] three-lobed leaves (Fig. 1) are large, d[...] green, glossy, rugose, longer than bro[...] paler and slightly hairy beneath and h[...] stiffly upright in a cupped-shaped man[...] by long, stout petioles tinged with red. [...] Viking and the Arnold Arboretum *pa[...]dum*, this cupping of the leaves is so p[...]nounced that soil sprinkled therein [...] readily supported by the foliage of [...] new shoots.[2] The leaf characters of [...] Arnold Arboretum plant of *pallidum* [...] Viking appear so much alike as to sug[...] that possibly they may be forms of [...] same *petraeum* hybrid.

Inheritance of Rust Resistance

If Viking, the origin of which is unkn[...] (5) is a form of the *R. petraeum*× [...]*rum* hybrid, its resistance to blister ru[...] probably inherited from the *rubrum* r[...]er than from the *petraeum* parent; [...] *Ribes petraeum* and some of its vari[...] and forms have been found to be sus[...]tible to white pine blister rust in var[...] degrees (3, 9, 10). The *petraeum*×*rub*[...] hybrid, *pallidum*, however, is reporte[...] Tubeuf (10) as being highly rust-resis[...] It would seem likely, therefore, that [...]sistance in *pallidum*, as in Viking, c[...] from the second parent rather than [...] *petraeum*. Resistance of the northern [...]ropean and Asiatic species, *Ribes rub*[...] to blister rust, is shown by certain f[...]ful varieties containing blood of [...] species, including Franco-German[3] w[...]

[2] According to P. Thayer, The red and white currants, Ohio Agr. Exp. Sta., Bull. 371, [...] currant foliage characters are important in separating species and varieties. He stated (p. [...] "If the foliage descriptions seem rather minute it should be remembered that next to the bl[...] the most constant characters in a currant variety and the most distinct differences between [...]eties are those found in the foliage on the new shoots."

[3] In preliminary tests the writer (4) found the variety Franco-German to be immune from [...]ter rust. In a recent report received from I. L. Conners, Pathologist, the writer was informed [...]ten communication) that this variety has proved to be immune from *Cronartium ribicola* in [...] tests carried on for a period of three years, 1935 to 1937, in the currant and gooseberry p[...]tions maintained by H. J. Read, Horticulturist at the Central Experimental Farm, Ottawa, C[...] Other susceptible black and red currants in these tests have shown moderate to heavy bliste[...] infection.

rther investigations may show definitely be immune, and London Market (1, . III), which Spaulding (9) and the iter (4) reported highly resistant. More- er Tubeuf reported the varietal form *ıbellum* Trautv. and Mey. of the species *brum*, in his list of the very few Ribes found to be immune or highly resistant blister rust (10). Previously the Swiss est pathologist, Schellenberg (8) had ɔorted *rubrum* to be resistant to blister st even in the immediate vicinity of avily infected black currants (*R. nigrum*).[4]

In consideration of blister-rust-immune *bes*, it is important to comment further on the probable parentage of Viking. the immune Viking contains *rubrum* ɔod, it is of interest here to note that s Linnaean species comes in part from ɔeria, the probable original home of ite pine blister rust. Moreover, in ster rust susceptibility tests now being ried on in the Canadian currant and oseberry plantations referred to in foot- te 3, a variety of black currant, *R. nig- n* Siberian Hort. Sta. 19/11 and *Ribes nchuricum* Komar, from northeastern ia, have both proved to be immune m blister rust for three years in field ts conducted from 1935 to 1937. Ex- ience in obtaining disease-resistant nts has shown that very often host cies or forms of those species, show- a high degree of resistance to a giv- disease, originate in regions where the ease has been present many years. It therefore, likely that *Ribes* resistant to ster rust are to be found in Siberia.

SSIBILITIES OF VIKING INTERBREEDING

Viking is self-fertile. Although it has been demonstrated, it is very probable t Viking is also capable of crossing h other red and white garden currants; for experience has shown that hybridization is readily accomplished artificially in the genus *Ribes*, particularly in this group of currants, due to the genetic nearness of the parent forms. In 1930-1931, Pavlova (7) pointed out that there were no special genetic papers on the genus *Ribes* but a number of facts dealing with this subject were to be found in papers by Janczewski and Lorenz. He further stated that interspecific hybridization in the genus *Ribes* is very widespread artificially among its subgenera, and that these hybrids show all the transitions from the very fertile to the wholly sterile species. Most of 45 interspecific *Ribes* hybrids known to Pavlova were "garden species" and had been produced by artificial interbreeding. He stated that the first hybrid to be discovered among cultivated plants was *Ribes ureclatum* Tausch (1838), a cross between *multiflorum* and *petraeum*, both belonging to the subgenus Ribesia. The origin of *urceolatum*, however, is unknown (1). Pavlova did not record any wild hybrids of *Ribes*. Moreover the writer is unaware of any wild *Ribes* hybrid reported in the literature of this country.

There appears to be very little available information on *Ribes* pollination. Currant pollen is distributed chiefly by dipterous and hymenopterous insects, especially bees, although the possibility of wind-borne pollen is not excluded completely. Inquiries addressed to several well-known horticulturists and entomologists, brought forth the following information (written communications). They are of the opinion that *Ribes* pollen is not carried very far and that there is no evidence that wind pollination is a factor. Furthermore, one horticulturist, who has had considerable experience in breeding *Ribes*, believe that the likelihood of inter-

[4]Schellenberg (8) also reported a variety, Rote Holländische, cultivated extensively in Switzer- l, as being likewise resistant to blister rust. It would be interesting to know whether the ss variety is identical with the Rote Holländische of Germany investigated by Tubeuf and ed by him to be immune.

breeding as the result of insect pollination, would be very remote unless susceptible currant varieties were growing within a hundred yards or so of the immune Viking. On the other hand one entomologist has informed the writer that bees sometimes fly distances up to a half mile. Since they continue to visit the same kind of flowers on which they started out in the morning, they might cross-pollinate plants within this distance, particularly if there were a number of them about. Inasmuch as lateness of flowering is an inherent character of Viking, its flowers opening somewhat later regardless of site, this factor might in itself tend inhibit crossing with the earlier bloomir susceptible red and white garden currai when these are growing in the vicinity the immune Norwegian variety.

In obtaining the naturally produc Viking seed for the inoculation expe ments described in this paper, no attemp were made to prevent interbreeding wi susceptible garden varieties. Furthermo Viking was not hand-pollinated with p len collected from susceptible red cu rants. Seed was gathered from Viki far enough removed to render crossi with these susceptibles extremely unlike

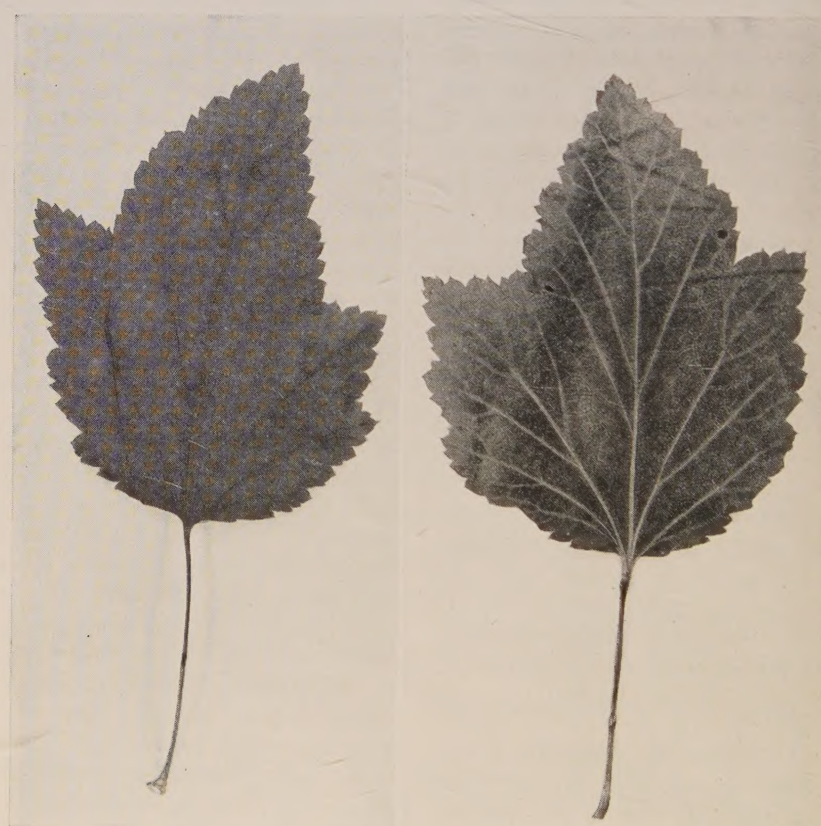

Fig. 1.—Leaves of *Ribes pallidum*, Arnold Arboretum. Note the unequal lobing similar to that produced by Viking. As Darrow has stated for the Norwegian variety, the right lobe is frequently the larger (5, pl. 1). (Left) Upperside of longer than broad, three-lobed leaf; (Right) Underside showing prominent veins. ½ nat. size.

ich an investigation should give infor-ation on what is to be expected in the ay of immune and susceptible seedlings om Viking growing in the field.

Materials and Methods

Seedlings of Viking were propagated at e March Botanical Garden, Yale Uni-rsity, New Haven, Conn., from seed llected in July. After collection it was parated from the fruit pulp, dried, and en stored in a refrigerator until late ptember or October when it was sown seedling flats in the greenhouse or in en cold frames out-of-doors, in a loam il mixed with peat moss. Ready ger-ination occurred in the spring, partic-arly in the cold frames, after the winter ulch had been removed.

Seed was obtained from both Europe d the United States. Through the co-eration of Stedje, two packets of seed ere obtained from Norway in 1932. This orwegian horticulturist reported the urce of the seed as follows (written mmunication): "The packet marked 'A' ntains seeds gathered from bushes stand-g near other varieties and consequently e seed may be the result of a cross-llination. The packet marked 'B,' how-er, contains seed from bushes where oss-pollination is debarred, for the bushes e standing alone—at a great distance om other varieties." In other words plants ocured from "B" seed were the result selfing as well as crossing between fferent Viking bushes. American seed Viking was collected in New England d New York in 1933 and 1934 from test ants planted for experimental purposes). The 13 localities from which seed as collected are listed in Table 1. mong these, the possibility of crossing th susceptible garden currant varieties was not excluded at Bar Harbor, Maine, at Holden and Worthington, Mass., and at Lewis and Peru, New York where sus-ceptible garden varieties were growing in the immediate vicinity of Viking. Where intercrossing was unlikely, susceptible varieties were growing many miles distant from the Viking. Both foreign and do-mestic seed produced a large number of seedlings having the same vigor of stem and leaf growth as that possessed by the hybrid parent from Norway. Furthermore, it was observed that a majority of Viking seedlings showed unequal three-lobed leaves similar in shape to those recog-nized as being characteristic for Viking (5, pl. 1).

The methods rigorously applied in ob-taining the results set forth in this paper, have already been described in a previous publication (2). Viking seedling leaves representing all stages of development from the tiny embryonic to the fully mature, were utilized in the experiments. Uninfected seedlings that had been atom-ized with tap water, were inoculated by dusting the moistened undersurfaces of the leaves with *Cronartium ribicola* spores obtained from aecial infections on can-kered 5-needle pine.[5] Throughout the in-vestigation an abundance of brightly col-ored, orange-yellow aeciospore material was available as inoculum. This was kept for use in an ice box during the inocula-tion season, which extended from April or May into July. In applying the spores, a generous amount of inoculum was util-ized in order to insure maximum infec-tion. Most of the inoculations were made with freshly collected aeciospores obtained from northern white pine growing in Connecticut, Maine, Massachusetts, and New Hampshire. Inoculations with fresh aeciospores from western white pine col-

[5]The writer is indebted to E. C. Filler and other members of the Division of Plant Disease ntrol, Bureau of Entomology and Plant Quarantine, for their hearty cooperation in providing ster rust inoculum for these experiments and to C. K. Goodling, Division of Forest Pathology, w Haven, for the photographs illustrating this article.

lected at Clarkia, Idaho, by R. P. MacLeod, were included in the 1935 tests.

The tests extending from 1933 to 1937 were performed in a pathological greenhouse of the United States Department of Agriculture at the Marsh Botanical Garden. The leaves of the resistant Viking seedlings of which there were a large number tested, were examined carefully several times during the summer to make certain that infection had not been overlooked. The "checks" utilized in the experiments were rust-susceptible wild *Ribes* species and included the following: prickly gooseberry [*Grossularia cynosbati* (L.) Mill.]; smooth gooseberry [*G. hirtella* (Michx.) Spach]; American black currant (*R. glandulosum* Grauer) and swa red currant (*R. triste* Pall.) The cu vated, highly susceptible American R Dutch garden variety [*R. sativ* (Rchbch.) Syme] also was used as additional check. These susceptible *Ri* served to demonstrate the viability of t inoculum used, as well as the fitness the time of inoculation with respect proper moisture and temperature c ditions for optimum rust infection (2).

It is important to call the reade attention to the fact that several pla of the above-mentioned species were ma tained in the center of the greenhou They were kept separate from other che

Fig. 2.—Comparison of even-aged (3-year-old) susceptible and immune Viking seedlings, grown from American seed, each tested 3 times. (Left) Susceptible Lakeville, Mass. seedling. The thin, pale green, abnormal leaves infected with blister rust were not removed. (Right) Immune Bar Harbor, Maine, seedling, showing thick, rugose, three-lobed leaves. Photog. Aug. 1937.

Fig. 3.—Comparison of uneven-aged, susce and immune Viking seedlings grown from collected in localities where Viking was iso from other varieties. (Left) Susceptible wegian seedling propagated in 1933 and t 7 times. Note abnormally thin, distorted le (Right) American seedling (Tuftonboro, N. propagated in 1935 and tested 3 times. seedling with three-lobed leaves is typica the majority of Viking seedlings that were mune from rust. Photog. Aug. 1937.

nts isolated for inoculation purposes. hough they were not inoculated ar- cially, each season these additional ecks in the center of the greenhouse be- ne *naturally* heavily infected with blis- rust, thereby indicating the presence free spores of *Cronartium ribicola* in greenhouse during the inoculation riod.

Results

During the 5-year period of testing, 33 to 1937, most of the inoculations re made from 1935 to 1937. A total 1,835 naturally pollinated Viking seed- gs were inoculated with *Cronartium icola* (Table 1). This number included 4 seedlings propagated from Norwegian ed and 1,511 seedlings from seed col- ted in the United States in New England d New York. Although none of the king bushes were bagged artificially to ure selfing, 1,086 seedlings, or 59 per nt of the total number tested, might, m a practical standpoint, be regarded selfed or intercrossed among them- ves.

In Table 1, the Viking seedlings are vided into two groups, one consisting plants derived from Viking growing ere the possibility of cross-pollination th compatible susceptible garden cur- nts seemed unlikely, and a second group seedlings produced by the Norwegian riety growing where cross-pollination th susceptible garden currants was not cluded.

Whenever possible, it was the purpose the investigator to test at least three nes, each potted, numbered Viking seed- g, upon which individual records were pt. This procedure could not always followed, however, in the case of im- ne and susceptible seedlings that suc- mbed during the testing to root rot, nter killing or other causes. In the esting of surviving seedlings discovered be immune in the first test, none were observed to be susceptible when tested further.

Among 324 numbered Norwegian seedlings (Table 1), 309 plants were found to be immune from blister rust when tested once. Repeated tests to prove immunity gave the following results: Of the 309 plants immune on one trial, 287 survived to be tested twice, and 248 were tested three times. It was also possible to inoculate certain of these plants more than three times to test immunity further: 77 were tested 4 times; 30 were tested 5 times; and 5 were tested 6 times. Of the total (324 plants) tested, 4.6 per cent were found to be susceptible.

A high percentage of immune seedlings likewise held for numbered plants propagated from seed of American origin. Among 791 seedlings (Table 1), 761 plants were found to be immune from blister rust when tested once. Additional tests to confirm immunity gave the following results: Of the 761 plants immune in the primary test, the 718 surviving plants had two tests and 665 had three tests. Because of a longer period for testing, it was possible to inoculate certain of these plants more than three times to test immunity further: 86 had 4 tests; 18 had 5 tests; and 1 had 6 tests. Of the total (791 plants) tested, 3.8 per cent were found to be susceptible.

The "unnumbered" seedlings cited in Table 1, footnotes 1 and 2, were of American origin and propagated from seed collected in 1934. These seedlings were not potted along with other plants from these flats for individual testing, but were allowed to remain in a crowded condition in the shallow flats. They were not inoculated until 1937, when sufficient inoculum was available. At that time they were heavily inoculated twice *in situ* with abundant aeciospore inoculum. When the final examination was made for rust susceptibility, the seedlings were cut away at the soil level so that any infected plants

would not be missed and each seedling could be examined thoroughly. Among 720 of these three-year-old seedlings from the 7 sources cited in Table 1, 3 per cent, or 22 plants were found to be susceptible.

A total of 1,835 plants (Table 1) of North American and Norwegian origin was tested, 3.7 per cent of which proved to be susceptible, and a total of 24,908 leaves was inoculated, 360 of which showed susceptibility. Among the comparatively large number of immune see[illegible] lings there appeared many that were ca[illegible] able of producing vigorous growth (Fig[illegible] 2, 3), similar to that of the parent Vikin[illegible] Probably among these vigorous, secon[illegible] generation seedlings of Viking, exi[illegible] plants that may prove to be not onl[illegible] fruitful, but also homozygous, that i[illegible] stable among their seedlings for the cha[illegible] acter of rust resistance.

The comparatively small number [illegible]

Table 1

RESULTS OF INOCULATING NATURALLY POLLINATED SEEDLINGS OF VIKING WITH CRONARTIUM RIBICOI[illegible] 1933 TO 1937

Source of seedlings	Plants inoculated Total	Immune	Susceptible		Leaves inoculated Total	Infect[illegible]
	No.	No.	No.	Per cent	No.	No.
Possibility of cross-pollination unlikely						
Norway, numbered seedlings	262	251	11	.	.	.
United States, numbered seedlings						
N. Augusta, Me.	26	26	0	.	584	[illegible]
Camden, Me.	98	97	1		1,830	[illegible]
Freeport, Me.	43	40	3		828	17[illegible]
Lakeville, Mass.	45	41	4		778	1[illegible]
E. Princeton, Mass.	8	8	0		203	[illegible]
E. Acworth, N. H.	19	18	1		340	[illegible]
New Boston, N. H.	108	104	4	...	2,292	3[illegible]
Tuftonboro, N. H.	59	55	4		954	1[illegible]
United States, unnumbered seedlings	418[1]	403	15		1,661	2[illegible]
Total numbered	668	640	28		13,029	23[illegible]
Grand total	1,086	1,043	43	4.0	14,690	25[illegible]
Possibility of cross pollination not excluded						
Norway, numbered seedlings	62	58	4		1,534	3[illegible]
United States, numbered seedlings						
Bar Harbor, Me.	216	208	8	.	4,274	3[illegible]
Holden, Mass.	49	46	3		803	1[illegible]
Worthington, Mass.	62	60	2	..	1,197	[illegible]
Lewis, N. Y.	44	44	0	.	784	[illegible]
Peru, N. Y.	14	14	0		342	[illegible]
United States, unnumbered seedlings	302[2]	295	7		1,284	1[illegible]
Total numbered	447	430	17	..	8,934	9[illegible]
Grand total	749	725	24	3.2	10,218	10[illegible]
Total number of seedlings tested						
Norway, numbered	324	309	15	4.6		
United States, numbered	791	761	30	3.8		
United States, unnumbered	720	698	22	3.0		
United States	1,511	1,459	52	3.4		
Norway and United States numbered	1,115	1,070	45	4.0		
Grand total	1,835	1,768	67	3.7	24,908	36[illegible]

[1]The sources for seedlings were as follows: Camden (195 pl. incl. 6 suscept.); Freeport ([illegible] pl. 3 suscept.); and Lakeville (68 pl.—6 suscept.).

[2]The sources for seedlings were as follows: Bar Harbor (206 pl. incl. 3 suscept.); Hol[illegible] (26 pl. 1 suscept.); Lewis (33 pl. 1 suscept.); and Peru (37 pl. 2 suscept.).

usceptible seedlings (Table 1) showed arying degrees of susceptibility to rust. They also varied in vigor and type of growth. The majority of the susceptible plants were inherently weak and from the ery start, even before they were inoculated, showed abnormal leaf development Figs. 2, 3). In some cases the leaves of he susceptibles, unlike the dark green, hick, rugose ones produced by Viking, were exceedingly thin, light green in olor, and showed the abundant presence of glands. Particular care was given the usceptible seedlings so that they would have every opportunity to survive. The eaves of these plants as they became infected were not removed as this practice would tend to weaken plants already subnormal in vigor.

Among the 45 (Table 1) numbered American and Norwegian susceptibles, 78 per cent (35 plants) were moderately to highly susceptible. Of this number, 33 plants grew poorly, including 18 plants hat did not survive. Only two plants among the 35 susceptibles showed pronounced vigor in vegetative growth. These wo plants, which were highly susceptible, ame from the Norwegian seed collected rom isolated Viking plants. No plants of this type occurred among the larger American population studied.

The balance of 45 numbered susceptibles, 10 plants, showed only a very light infection with blister rust. Further ests should be made with the highly esistant plants to determine their future eaction to *Cronartium ribicola*. More over all of the fully susceptible plants hat have survived, will be carried on to discover whether they will eventually produce flower and fruit. It may be that ome of the susceptible plants are sterile, .e., complete susceptibility may be linked with sterility.

It was difficult to judge the vigor of he unnumbered susceptibles because rowding had interfered with normal growth. It was observed, however, that these susceptible plants were quite small and had produced a limited leaf development as compared with many of the more vigorous immune seedlings which had outgrown them.

As in previous investigations, necrotic flecks (3) were formed in the leaves of the immune seedlings. These were of the same type as those occurring in inoculated Viking leaves. In no instance were abortive uredia or telia found in association with the flecks. On the other hand, the susceptible *Ribes* spp. included in the tests, in each inoculation test became infected with blister rust.

No appreciable difference could be found between the percentages of susceptible seedlings occurring in total populations obtained from seed collected from isolated Viking bushes and from bushes growing near susceptible red currants. A total of 1,086 plants (Table 1) grown from seed gathered in isolated localities, gave 4 per cent susceptible seedlings, and a total of 749 plants (Table 1) grown from seed taken in localities where the possibility of interbreeding was not excluded, gave 3.2 per cent susceptible seedlings. The evidence here indicates that Viking did not cross with susceptible plants in the vicinity of areas where seed was gathered. Furthermore, the small percentage of susceptibles obtained indicates that there is a small proportion of the total Viking seedling population having a heterozygous constitution for resistance.

Summary

A small percentage of plants susceptible to white pine blister rust (*Cronartium ribicola*) was obtained among naturally pollinated seedlings of the fruitful, rust-immune Viking currant (syn. Rød Hollandsk Druerips) from Norway, growing where the possibility of cross-pollination with susceptible red and white currants was not excluded, and in other

localities where cross-pollination with susceptible garden currants seemed unlikely. A total of 1,835 seedlings of North American and Norwegian origin were tested, 3.7 per cent of which, or 67 plants, proved to be susceptible. The remainder, or 1,768 plants, were rust-immune. In all, 24,908 leaves were tested and of this number only 360 produced blister rust fruiting bodies. The conditions for artificial inoculation are described.

Necrotic flecks appeared on the young inoculated leaves of the immune Viking seedlings. Neither uredia nor telia were observed associated with the flecks. Moreover flecks did not appear on the fully mature leaves of the immune plants. On the other hand the susceptible currants and gooseberries used as "checks" became readily infected throughout the inoculation tests.

For the most part, the immune seedlings resembled the hybrid Viking parent in that they grew vigorously, generally producing irregularly shaped, three-lobed leaves similar to those described for the parent, Viking, which probably is a form of the artificially produced hybrid species, *Ribes pallidum* (*Ribes petraeum*×*R. rubrum*).

The susceptible Viking seedlings varied in degree of susceptibility to rust and in vigor of growth. Among the numbered susceptibles (45 plants), upon which individual records were kept, 78 per cent were moderately or highly susceptible. Of these only two plants showed vigor of growth, whereas the others either grew poorly or did not survive. The remainder of the numbered susceptibles (10 plants) showed a high degree of rust-resistance and were almost completely immune. In this case resistance was associated with vigor in growth.

Considering the very small percentage of suceptibles appearing among the total Viking seedling population studied, the indications are that probably a very small percentage of the seedlings are heterozygous whereas the majority of Viking seedlings must be homozygous, rust-resistance being a dominant character in the parent. Furthermore, the evidence indicates that there may be multiple factors involved in the inheritance of resistance, for susceptible Viking seedlings were not uniform in their susceptibility, some presenting a high degree of rust resistance.

The parentage of Viking is discussed, together with inheritance of rust resistance in the variety and possibilities of its interbreeding with other currants.

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Connaughton to Direct Rocky Mountain Station

CHARLES A. CONNAUGHTON, a Senior member of the Society, was appointed director of the Rocky Mountain Forest and Range Experiment Station at Fort Collins, Colorado, effective July 1. He succeeds Dr. R. E. McArdle who was recently appointed director of the Appalachian Forest Experiment Station, Asheville, North Carolina.

Mr. Connaughton obtained his B.S. degree from the University of Idaho in 1928, and his M.F. degree from Yale in 1934. He was first appointed to the U. S. Forest Service in 1930 as ranger on the Targhee National Forest in Idaho, and for several years was associated with the Intermountain Forest and Range Experiment Station at Ogden, Utah. He was transferred to the Rocky Mountain Forest and Range Experiment Station in 1936.

He is secretary of the Central Rocky Mountain Section of the Society.

A SAVINGS BANK INVESTOR LOOKS AT FORESTRY[1]

By EDGAR C. HIRST
Savings Banks Association of New Hampshire

There are not many men in America who have been trained in and have practiced forestry, who have engaged in the lumber business, who have served in the capacity of a state tax commissioner, and who in the end find themselves engaged in the banking business. Such a man, however, is the author of "A Savings Bank Investor Looks at Forestry." Readers of this article will find it entirely devoid of theoretical financial considerations. Instead, they will find an abundance of the common garden variety of "horse sense." Although the author does not paint too rosy a picture of the possibilities of forest practices in New England, it is nevertheless reassuring.

I WAS asked to speak on the subject "A Banker Looks at Forestry." I asked that it be changed to read, "A Savings Bank Investor Looks at Forestry." Not that this change would alter what I might say, but it identifies the kind of banks I represent and thus gives you at the start a better idea of my viewpoint. Banking today covers a wide range of activities and there are many institutions called banks which perform widely different services. I will discuss three important types of banks, the commercial bank, the investment bank and the savings bank, and their respective interests in forests and forestry.

The Commercial Bank

This is the ordinary bank where one keeps one's checking account. This bank keeps on deposit a substantial part of its checking account deposits, ready to cash checks when they come in. It keeps a required reserve, usually at the nearest federal reserve bank. It invests the balance of its funds in such securities as it may legally buy, and it makes loans to individuals and companies to carry on their business. The most direct relation the commercial bank has to forestry is in loans for timber operations. In placing such a loan the bank's interest is in the ability, character, and credit of the operator; the quality and accessibility of the timber and the market for the product. These determine the propriety of the loan. Commercial banks also make loans to manufacturers who use forest products in their processes. Here they have a direct interest in the continuing supply of raw materials. Before making such a loan commercial banks are much more apt than formerly to inquire about the accessible supply of timber and how long it will last.

The Investment Bank

The function of investment banks is the furnishing of large amounts of money for business enterprises, to be paid back with interest over long periods. If a manufacturer, merchant, utility company, or other enterprise needs several million dollars for rebuilding or expansion, it may go to the investment banker who, incidentally, is no longer connected with a commercial bank. If the investment banker is satisfied after investigation he *underwrites the issue;* that is, he agrees to furnish the money by selling the bonds of the company to the public. Here the direct interest in forestry has been in the case of timber bonds, numerous issues of which were sold several decades ago, their retirement being provided by a stipulated deposit for each M. feet of logs removed. In such bonds there was no interest in future growth. In later years

[1]Presented at the Annual Meeting of the New England Section, Springfield, Mass., March 1938.

bonds have been issued by manufacturing concerns using timber as a raw product. With these there has been an increasing tendency to regard growth as an important factor. Clearly the investment bank is not a bank at all in the ordinary sense; it is an underwriting agency.

The Savings Bank

The savings bank was originated by a parish minister in Scotland in 1810, who wanted to help his parishioners improve their economic condition. The first savings banks in America were started before 1820; over 500 of them are located in the states from Maine to Maryland, and some are located in other parts of the country. Practically all of them are mutual institutions. They receive deposits from people who wish to save, mostly small savers. This money is invested in securities approved by the laws of the several states in which the banks operate, and in loans secured by mortgages on real estate. The savings banks in small cities and towns lend a good deal of money on farm mortgages at 5 per cent, running up to 20 years. Timber growth is often an important part of the realty securing the loan. In fact, in many instances, the growth and maturity of the timber is anticipated to make the final payment on the loan and leave something substantial for the owner. Until recently the care of the forest, or forestry, has not been an important item in making such loans. It is beginning to be appreciated now by the banks, especially in cases of loan renewals or extensions.

Savings banks are not banks in the ordinary sense; they are mutual savings societies. In New England they probably have contributed more to the economic upbuilding of the average person than any other institution. My position is that of executive officer of a savings banks protective association which includes all the savings banks in my state, and whose object is the protection of the small savers who are the depositors.

Qualities of a Good Savings Bank Loan

I would like now to consider the forest as an investment for a small investor. Before doing so let me state the qualities of a good savings bank loan. They are value, income, and liquidity. (1) The value of the asset must be greater than the loan. In many states a savings bank is not allowed to lend its depositors' money in an amount greater than 70 per cent of the value of the property offered as security. (2) The income from the loan must be regular. Formerly this meant that the borrower annually or semi-annually paid the interest and something on the principal. Lately, the practice of paying loans by the month has increased very much in the case of mortgages and has been found mutually beneficial to the borrower and the institution. (3) The loans should be reasonably liquid; that is, if the bank found it necessary to do so the loan should be of a good enough character so that it could be sold to some other institution, or a reasonable amount of money could be borrowed against it.

Now a forest by its very nature does not qualify under the requirements of regular income or liquidity. Its worth as an investment must therefore rest on the value of the property now, and its prospective value, in comparison with other forms of investment.

A Forest as a Private Investment

I would like to compare the investment value of a forest now with what it was 30 years ago. For this purpose we must use the same forest under the two sets of conditions. Therefore, let us assume that in 1908, 30 years ago, *A* owned 500 to 1,000 acres in the pine region of New England, with 1/3 of its area in mature or merchantable timber; 1/3 in half-grown trees, salable but not of good quality or size; and 1/3 well stocked

with young growth. Let us assume that it is a fine forest of mixed growth and that it is 3 miles from a railroad loading point and 15 miles from a milling point. Then 30 years later, in the year 1938, *B* owns a forest exactly like it as to area, stocking and all physical characteristics. Now let us compare the investment value of the forests of *A* and *B*.

Safety from Destruction

Fungous diseases and insect pests are ever present. More is now known concerning these destructive agents than was known 30 years ago; but because the danger from new pests and the recurrence of old ones cannot be predicted we cannot compare the two forests in this respect.

In the matter of fire protection we can make comparison and there is a decided improvement. *A's* forest was not under observation from any lookout station for there were none, and there was no organized forest fire protection in our country towns. If a fire started near *A's* forest little effort was made to put it out unless or until it threatened buildings. The forest was back from the main roads and not frequented by people. Hence the hazard was low. But if a fire started it was likely to be very destructive.

B's forest is more accessible on account of improved roads; it is used more by the public for hunting, fishing and general recreation, but it is under constant observation from a lookout station. Also a town fire warden or deputy lives in the locality, fire fighting equipment is available, and if a fire starts people actually get busy and put it out. The safety factor for *B's* forest is greater than for *A's*.

Accessibility

Let us assume that both *A* and *B* live in the town of *X* where is located a sawmill which is 15 miles from the forest. When *A* wanted to visit his forest he took the morning train to the R.R. station nearest the forest and there hired a horse and buggy, or walked the 3 miles. He carried his lunch or got dinner at a nearby farmhouse, and after attending to his business went home on the evening "local." It was an all day job for which he planned some time ahead. Needless to say he did not see his forest often, probably not once a year unless there was urgent business.

B does not take the train or hire the horse and buggy. There is no horse and buggy, and the local train has been discontinued after a hearing attended by several hundred indignant citizens who hadn't used it for years but apparently wanted the railroad to go on operating it for fun. There is, however, a cement highway going out the valley and a hard-top branch road going right by the forest. Any day *B* can knock off work a little early he can arrive on his forest in 30 minutes. He can do better than this if the motor cop is on the other end of the beat! He does this rather often. He has met and talked with foresters and knows more about forestry than did *A*; and these trips help him to forget for a short time the extremely low yield on the high grade bonds he is holding as trustee for the local hospital and the many more business troubles and doubts which *A* did not have to worry about. *B* is therefore more familiar with his forest and in a general sort of way has more plans for its management and continuity.

Marketability

All of the merchantable timber on *A's* forest was salable. That was the heyday of the portable steam sawmill and stumpage and lumber prices were on the up and up. *A* could either hire a mill man to operate his timber from stump to stick at an agreed price and sell the lumber himself, or he could sell the timber for cash. If the latter, the sale could be made

y private transaction or by auction. In ny case, if reasonably shrewd, he got $5) $6 per M. feet stumpage. The timber, owever, was sold as a whole. The area 1 half-grown trees was cut as well as hat in mature timber. A steam sawmill as moved onto the lot and every tree hat would make one round edge board nd two slabs was cut. All that was left as the young growth, and from this the ardwood was removed during the cord-ood cutting that followed the lumbering peration. All lumber and wood was auled by team to the railroad loading oint 3 miles away, and shipped from here to different consuming centers.

B's forest is in a very different situa-on as to marketability. As this is being ritten on March 1, 1938, it may be said uly that there is no market for *B's* tim-er at any reasonable price. Up to Oc-ber, 1937, there was a fairly good mar-et for logs and lumber but, along with e most rapid recession in the history of merican business, the value of *B's* tim-er has slumped now to about the zero oint. If we assume that this condition going to continue there would be no se in speculating on the unknown possi-ilities. Hence, let us assume that a mar-et at least as good as 1937 will be avail-ble. Even so, *B* will not find the same pportunity to sell his timber as a whole *A* did. If he did it would be on the asis of the mature timber only. The alf-grown trees would scarcely figure in e transaction. They produce only box oards, the market and price for which ave declined until the young trees rep-esent very little stumpage value. The nly real sale value is for the mature or ood merchantable trees. For these the umpage price is about what prevailed r all the trees (large and small) on *'s* forest.

B can still get his good trees logged d sawn by a portable mill. But there e not so many of these operators about as formerly, and *B* is less sure of a good sale for the lumber when sawn than was *A*. One thing, however, is left for *B's* benefit which *A* had completely over-looked or which was not available to *A*. In the town of *X* where *A* and *B* reside, is a stationary sawmill. This mill has been doing business a long time but late-ly, with the improved roads, the decline in portable mill operations, the improve-ment in the market for building lumber and the insistence of that market upon well manufactured lumber, the stationary mill has been re-conditioned and has in-creased its output. The owner of the sta-tionary mill will buy *B's* logs delivered at the mill. The prices offered are based on size and quality. As we noted before there is a hard-surfaced road to the tim-ber lot and there are plenty of truckmen willing to work hard and risk the trucks they have paid for with slow notes. *B* finds he cannot cut the small trees and deliver them for what the mill owner is willing to pay, and still leave any ap-preciable value. The good timber, how-ever, will yield him a fair stumpage price. His decision therefore would be to cut the mature timber only. This would leave *B's* forest with a good growing stock. He could look forward to another cutting during his lifetime from what are now the half-grown trees. As for im-proving the growth by the cutting of in-ferior trees, *B* has not so good a chance as had *A*. Although many men are out of work and he is helping to support them through taxation, there are fewer good woodchoppers available, and woods labor of any kind is harder to get. Also, the increased use of oil and gas has re-duced the demand for fuel wood. Al-together, we may say that the liquidity (that is, conversion or sale value and bor-rowing ability) of *B's* forest is 1/4 or 1/3 less than *A's*. But he would have good value in prospect after cutting, which *A* did not have.

Prospective Value as an Investment

The terms "a good investment" and "a bad investment" are relative. Any form of property has a good or bad investment value in comparison with other investments available at the time.

When *A's* forest was cut it could scarcely be called a good investment from any knowledge available at that time. It is true he was at the threshold of a rise in stumpage prices which continued for over 15 years, but he could not be expected to know this; so his investment must be judged by the opportunities for investment as they then existed—in 1908. What were they? Money deposited in savings banks was paying 4½ per cent; a carefully selected list of stocks and bonds would yield 6 per cent or more, and so would many conservative private investments. His timber was not growing at that rate and he did not know the risks of invested capital, which he found out later to his sorrow. When the timber was cut *A* invested the proceeds at an average return of 6 per cent and concluded he was better off. But assuming he was the average business man, he later reinvested his funds and as a result, in the years after 1929, lost from 1/3 to 2/3—let us say ½—of his principal. However, that is hindsight and not foresight so we must conclude that from all the knowledge existing in the year 1908 *A* was justified in thinking that the money tied up in his timber was worth 6 per cent to him.

B has no such investment opportunities awaiting the returns from his timber cutting. He has no more knowledge of future values than had *A*, but knowing *A's* experience he has more caution, and he will consider only conservative investments. What will such investments yield? Money deposited in savings banks will pay 2½ per cent; government bonds of short or moderate maturity yield even less. A list of what might be termed high grade stocks and bonds could be carefully selected to yield 4 per cent. He wishes to spread his risk and invest conservatively so he concludes the money from the sale of his timber is worth 3½ per cent to him. He has looked over his forest and thinks the annual growth is nearly as much. In this he may be mistaken, although the method of timber removal he uses later will have a good deal to do with the rate of growth afterwards.

As to carrying charges, we then reckon the interest on *A's* investment in his forest at 6 per cent and *B's* at 3½ per cent. In the other chief item of carrying charges —taxes—*A* was better off. His timber was cut before our New England towns had done much re-valuing of woodland and when the tax rates were low. For *B's* forest we must make two suppositions: if located in an organized town in New Hampshire or Maine the annual tax will be 3½-4½ per cent on 2/3 to full value; say conservatively 3 per cent on full value. If located in Connecticut, Massachusetts or Vermont, I am told that by legal means he may be subjected to a more reasonable tax. However, there are other things besides taxes about which *B* is worried. In conclusion let us consider them.

There are strong forces influencing *B* to hold his forest or cut it conservatively. They are in order: (1) The small stumpage value of the salable but half-grown trees. (2) The low yield on high grade investments into which he could put the proceeds of the sale. (3) His desire to keep his property productive.

The latter desire has been stimulated by his contact with foresters and the examples of forestry he has seen on other woodlands. Last year, before the big and sudden business slump, *B* was about ready to make a beginning by cutting a portion of the large timber and selling the logs delivered at the stationary sawmill. Then he began to hear talk about regulating private timberlands. What he heard and

read was vague at first. It all had to do with general patterns of administration for carrying out certain principles of production on a nation-wide scale. He knew the state forestry officials and liked them. He had expected that sooner or later they would be given some reasonable regulatory power over the cutting of forests. But what seemed in prospect now, looked like regulation from a long way off. It was to be by men of good report but whom he did not know. He felt their chief interest might necessarily lie with large timber areas and his own property might fare badly. He had seen other public measures intended to deal justly with the great and the small, and without going deeply into the causes, he had observed some of the effects at close range. Furthermore, he read of proposed plans to regulate selling prices. He wondered if this might later apply to the products of his forest. He also read about the proposed reorganization of government departments; and he understood this meant the forestry administration would be transferred to another department of the government. He wondered what effect this would have on forest regulation, prices, etc. Specifically, he wondered whether or not the good forestry men would be in a position to regulate wisely, or would be supplanted by other men about whose ideas he knew not. In the face of all this, *B* thought he might better sell out his forest and call it a day; but he hesitated, and while trying to make up his mind, the big slump in values started and his chance to sell slipped away.

During the business debacle of the past six months, *B* has spent much time in his forest, thinking over what he is going to do with it. He has made his decision. It is, that he will keep his forest, cut it conservatively and only when prices are favorable, and try to build up its value and productive capacity. How did he arrive at this decision?

A while back I said there were three forces which tended to make *B* hold his forest as an investment and cut it conservatively. There has been added one other strong and presently rather compelling argument; namely, the danger of inflation. *B* does not understand the intricacies of present day public finance. He has met very few men who know much about it and in all of the books, magazine articles and lectures he has read and heard, the subject in his mind has been only partially cleared, but a few things stand out that he thinks he knows. In countries that have experienced inflation followed by complete or partial deflation *B* understands that physical things such as buildings, manufacturing plants, merchants' and manufacturers' inventories and the raw materials of forests and mines, tend to hold their value; while the worth of the paper evidence of these things tends to decline or disappear. He understands further that this country now, and probably for some time to come, is committed to the principle of *managed money* instead of free exchange. He has not seen this principle work itself yet into a well-ordered system. He hopes it will do so, but he now believes that it is well to keep a reasonable part of his whole estate in physical property. He therefore has decided to keep his forest as a hedge against what he hopes will not happen. It gives him a little sense of security which other forms of property do not give in the degree they did formerly. *B* believes his forest would be with him after any possible inflation and deflation had run their courses. If public regulation comes he will take his chance with it, believing that in the end reasonable regulation in the public interest will be developed through the states, which will not be subversive of his own proper business interests. Recently he has heard of the work of woodland owners cooperatives. He thinks here may be something

which will help to protect the small private owner against unwarranted measures of regulation. So, all told, he has decided to keep his forest.

Here I end the story, for we have arrived at the situation in which *B* finds himself on March 2, 1938. In a word, if we rest our case on value, *B's* forest is not such a bad investment today compared with others. I did not wish to deal with this subject by means of statistical comparisons on rates of return which are largely theoretical, because we cannot predict them. I chose to present it from the standpoint of general investment on the part of the small investor and by familiar examples.

Thirty years ago I started in the forestry profession and worked at it eleven years. I then manufactured hardwood lumber and furniture for seven years. Then for eight years I was a tax commissioner in New Hampshire. Now I am engaged in a cooperative undertaking to protect the depositors in savings banks. It is said that when men approach second childhood they return to the follies of their youth. I hope I am not approaching dotage. But I now have—yes, I have always kept—a pure affection for my first strong impulse—the management of woodlands which is the business of forestry.

I knew a great many *A's* of 30 years ago; today I know a great many *B's*. My great regret is that I cannot live to see the development of this fine piece of mythical woodland as it passes to its successive owners—*C*, *D*, and *E*.

New Booklet on Road Building

Good Low-Cost Roads is a new booklet issued by the Allis-Chalmers Manufacturing Company. Although published primarily to promote a better public understanding of road building, it contains interesting, non-technical information on the various types of roads, the materials used in their construction, and their approximate cost.

The booklet may be obtained free of charge from the Allis-Chalmers Manufacturing Company, Milwaukee, Wisc. Please mention the Journal of Forestry when writing for your copy.

RECENT DEVELOPMENTS IN FORESTRY EDUCATION IN EUROPE

By NELSON C. BROWN

New York State College of Forestry

Discussions of educational problems are always interesting. First hand observations of educational trends in nations where forest practices have become more stabilized than in America are doubly interesting. On his recent trip to Europe Professor Brown observed that in France and in Germany the period of training for professional foresters is much longer than in America. It is more than likely that American forest schools soon will find it necessary to increase the length of the course in order to give the student adequate training to meet the complex problems that will confront him.

AN American forester traveling in Europe is at once impressed by (1) a strong trend toward and greater emphasis upon forest utilization problems and (2) a trend toward more extended periods of preparation for a professional career. The latter trend is particularly noted in France and Germany where a forester is generally from 25 to 28 years of age before he is ready to begin professional work. This is quite comparable to the present situation in the medical and legal professions in this country, but quite unlike that in the engineering profession which has adhered to the shorter periods of training with emphasis upon experience after graduation, in order to qualify for advancement into the more important positions.

Evidence substantiating the former trend is shown by the establishment of permanent and effective research laboratories in forest utilization at six different locations in Germany under the new 4-year plan, and by the founding, in 1934, of a separate school of forest utilization at Paris supported by the French government. The latter is known as the Ecole Superieure du Bois. These trends were forcefully brought forward at the International Congress of Timber Utilization at Paris, where strangely enough, from the American viewpoint, the emphasis on the protection, defense, and expansion of markets for wood, was led by foresters and by governments owning timberlands in friendly cooperation with lumber manufacturers, timberland owners, and importers and exporters of timber products.

Only graduates of properly qualified schools who must also pass a rigid examination are eligible to enter this school. A degree corresponding to timber engineer or wood engineer is given after the one-year course. Previously, men attended the French School of Forestry at Nancy for instruction in forest utilization, but in 1937 this plan was changed. Students at Nancy now attend the school in Paris for four months during their second year just prior to graduation. There are now about 25 students in each of the two classes in Nancy, and there are about 25 students in the graduate school of forest utilization in Paris.

A student must have a bachelor's degree before attending the school at Nancy. After this degree is received he must have two years of work in a polytechnic school and then two additional years at Nancy. Thus one must have had four years' college work after receiving the bachelor's degree and one year of military service before being ready to enter the French Forestry Service. Thus a student must be at least 25 years old when graduated. Practically all graduates of Nancy go into the government service, and it is considered necessary to have this additional work in forest utilization to round out their training before entering their professional careers.

In addition to forestry students at Nancy, the graduate school of forest utilization in Paris is attended by officers of the Army and Navy interested in timber construction, by private and consulting engineers, by railway maintenance of way engineers, by those employed by the government telegraph and post bureaus, and by some foreigners who wish to secure advanced work in the technical properties and utilization of wood. The faculty consists of a director, two regular members of staff, and 25 special lecturers obtained from Nancy, other technical schools, and the industries.

Probably the largest and leading school of forestry in Germany is at Munich, where 80 students are now in attendance. The educational requirements for a student going through the school at Munich is as follows:

4 years of elementary public school

8 years of grammar and high school

1 year in the "Arbeitsdienst," or work camps corresponding to our C.C.C. The requirement became effective in 1934. Every young man in Germany before reaching the age of 20, and irrespective of his financial position, must attend these camps.

1 year of military service

4 years of university work

The average age of freshmen is about 21 years. There is an examination after 2 years and a final examination after 4 years.

After graduation the students enter a three years' period of practical training which is strictly probationary in nature in the state or federal Forest Service. A final examination is taken for permanent employment. Thus the average age of a university graduate is 25, and by the time he is ready for final employment after the probationary period, he is usually 28 years of age.

These graduates receive about 180 marks per month, or approximately $720 per year, and are appointed as "Forstassessor," corresponding somewhat to our U. S. Forest Service title of Junior Forester.

Under the new four-year plan in Germany, more and more graduates of forest schools are seeking employment with private industry. With the expansion in the field of forest utilization, particularly in the plywood and veneer industries, cellulose, pulp, and other chemical products, as well as in the greatly increased wave of construction one finds through Germany, there is a great increase in and opportunity for employment for graduate foresters in these industrial enterprises.

In this country we have taken a rather narrow and constricted view of the field of forestry until quite recently. If the 25 professional forestry schools are training 5,000 students for public employment, federal and state, there are likely to be many heartaches and disappointments. Hundreds and perhaps thousands of trained college men are going into the forest industries every year in this country. These should have some knowledge of the objectives of forestry and certainly of the technical properties of wood and how it may best be utilized to serve mankind. The American forest schools are the places to train these young men for private industry, just as they are doing in Europe.

France, although deficient in timberland area per capita, and in spite of the high price of wood, is not using its annual growth because the demand for fuelwood and some of the other products is diminishing. However, because of the increasing use of wood for the approximate 20,000 automobiles now operating on wood and charcoal gas in Europe (and many more will likely be operating in a few more years), because wood is replacing metal for gears and for many products formerly manufactured from metals,

and also because wood is becoming an important source of material for textiles and animal food, it seems likely that the province of forest utilization will vastly increase in Europe.

Longer periods of educational training than those in America are recognized as necessary in several European countries. Possibly the opportunities for professional services in the United States have not been properly defined or their possibilities clearly recognized. Here there are almost as many different definitions of forestry and its objectives as there are definers. Certainly the scope of the field has broadened. Are we ready to determine exactly what training a student should have for a profession, the definition of which has not yet been agreed upon?

Data Sheets on Radio Transmitters Available

THE Collins Radio Company has recently issued data sheets on several radio transmitters suitable for forestry communication service. Specifications and descriptive information are available for the 30J high frequency transmitter; the 32MA 50-watt, single frequency, AC power transmitter; the 32G 40-watt transmitter; and the 45A transmitter.

These data sheets may be obtained from the Collins Radio Company, Cedar Rapids, Iowa. Please mention the JOURNAL OF FORESTRY when writing for them.

Community Forests

MORE than a thousand community forests, owned by towns, counties, suburban districts, and other local divisions, are in existence in the United States.

New York has the largest number of community forests publicly owned by local communities—390 forests, covering 188,000 acres. California is second with 158, and Massachusetts third with 125. In area, Wisconsin leads with 1,750,000 acres in 25 county forests. Other states with locally owned forests are: Connecticut, 23; Maine, 8; New Hampshire, 83; Vermont, 42; Pennsylvania, 34; New Jersey, 6; Maryland, 7; Alabama, 5; Georgia, 5; Tennessee, 4; North Carolina, 37; Florida, 2; Illinois, 7; Indiana, 2; Ohio, 21; Michigan, 45; Missouri, 21; and Oregon, 36.

Some community forests have been acquired for protection of watersheds; many as a result of tax delinquency—particularly after clean cutting of the original timber. A few are original reserves, and some communities have purchased tracts to round out areas of tax-delinquent lands. Many forests are already paying their way and returning a profit.

PLANTING EXPERIMENTS IN THE NORTHEAST

By HENRY I. BALDWIN

New Hampshire Forestry and Recreation Department

A survey of numerous planting manuals, leaflets, and reports issued by state, federal, and private agencies during the past 30 years suggests that there has been little change in technique or methods of planting recommended to the private owner. This paper summarizes the experiments designed to test the effectiveness of different methods as measured by survival and growth of the trees.

A SERIES of experiments was started in 1926 in connection with Brown Co. planting operations for the purpose of finding the best methods for reforesting abandoned farmland in northern New England. Series of sample plots were established in Milan, N. H., and Grafton, Me., to study plantation development, and in order to test different methods of planting. Experiments by the New Hampshire Forestry and Recreation Department in planting methods had been under way for many years and in 1933 additional plots were planted at the Fox Research Forest, Hillsboro, N. H.

Season: Spring vs. Fall Planting

The period in the spring between when the trees can be dug and when terminal growth begins is often short, and is a serious handicap on large operations. The nursery shipping force is also overloaded during the busy season. Planting at other seasons would distribute this load. Planting in the fall is often more convenient for the farmer and land owner. Previous experiments by the N. H. Forestry Department had shown that red and Scotch pine suffered severe losses when planted in the fall.

The Hillsboro experiment was started in the fall of 1933 and planting continued through the spring of 1935. Red, white and Norway spruce, red, white, and Scotch pine, and balsam fir of 3 different sizes of stock, 3-0 root-pruned, 2-2 and 2-3 were planted in parallel rows 5 feet apart. In the fall trees were set 10 feet apart, and the intervening spaces filled the following spring with trees of the same size and from the same lot in the nursery. Alternate rows were planted with a planting iron, others with a grub hoe after scalping off the heavy sod. Each row was staked and numbered, and trees planted in the spring marked by small stakes. The planting site was an abandoned hayfield on a ridge top, sloping gently to the east. The elevation was 800 feet. The soil was a rich loam, very heavy and the competition from weeds was severe. The first series was planted in October 1933 and May 1934; the second series September 1934 and May 1935. About 1,975 trees were measured for two years in the Hillsboro experiments. Unfortunately an insufficient number were included in each treatment to permit of statistical analysis.

Red Spruce.—Spring planting was slightly but not much better than fall planting. When planted either in the spring or in the fall 2-2 stock made better growth than 3-0 stock due to weed competition. Both growth and survival were better with hole planting than with planting iron.

White Spruce.—Little difference was apparent between seasons of planting. Survival was about the same. Hole planting in the spring was more successful with 2-2 stock; and by the planting iron with 3-0 stock; in the fall the reverse was the case.

Norway Spruce.—Survival and growth

were about the same for spring and fall planting. Hole planting was slightly better in all cases. There was a minor advantage in favor of spring planting for 2-3 stock.

Red Pine.—Survival was over twice as good in spring as in fall planting and growth 20 per cent better. (Due to the heavy sod 2-2 stock had a higher survival and growth in all cases than 3-0.

White Pine.—The best growth and survival were secured with fall-planted stock. Trees planted with the iron made considerably better growth and had somewhat better survival than those hole-planted. Better growth was made by 3-0 stock than by 2-2 stock.

Scotch Pine.—Survival was much better in spring planted stock. While use of the planting iron resulted in slightly better survival, growth was greater in trees planted with a grub hoe.

All Species.—A general weighted average of about 10 per cent better survival for spring planting and 7 per cent better growth for fall planting was indicated.

The differences between spring and fall planting were not great, except for the hard pines, which obviously never should be planted in the fall. Generally the same trend continued in the second measurement and was often intensified, i.e., a rapid growth rate the first season was usually sustained and the difference increased the second season, reflecting the advantage gained by a good start. Trees firmly established and able to overcome competition of grass and weeds were able to improve their advantage, while those suppressed, lost ground the second season.

Comparison of Hole and Slit Methods

The experiments were undertaken to test the feasibility of the so-called slit planting method in comparison with the often more laborious and slower hole planting method. The slit planting method and the similar one-man grubhoe method are often satisfactory in planting pine on sandy soils, where sod is not a serious obstacle. In slit planting using a planting iron, no sod was scalped off, but a slit was opened directly in the ground, the tree roots inserted, and the sides pressed together. For comparison, alternate rows were planted in holes dug with a grubhoe after removal of a 1 foot square of sod.

In general hole planting was found to be superior in survival and growth rate for the first year or two, and the head start thus obtained suggests that the hole-planted rows may retain a dominant position in the stand. An exception was the case of fall-planted spruce, where frost-heaving was reduced under the slit method, but growth of hole-planted stock was usually definitely better. Older stock tolerated slit planting better than small seedlings, which were buried in the deep hay, and succumbed to the competition of the heavy sod.

Planting in Ploughed Furrows

Ploughing single furrows about 6 feet apart was tried in order to break up the sod and remove it from close competition during the first year. Trees were planted in the furrows and in the sod midway between the furrows using a straight planting iron. All planting was done by the same crew and on the same day, using the same lot of stock. Owing to the extremely hot and dry spring and summer of 1934 the results may be taken as an example of the effect of extreme conditions on the two methods. Growth the first year was slightly more rapid in the furrows. There was little difference in survival the first year. Red spruce showed the greatest difference, and with this species both growth and survival were distinctly better in furrows.

The last year's growth of the same trees was again measured in the fall of 1936, and a much greater difference was found in favor of the trees in ploughed

furrows. An average of 1 inch greater height growth was found in the third growing season for trees in ploughed furrows. The reasons for better results after ploughing were believed to be (1) reduction of grass competition, (2) conservation of water in the furrows on dry sites, and (3) better aeration of the soil, facilitating root penetration.

Summary

Planting experiments in northwestern Maine and in New Hampshire demonstrated that:

1. Fall planting resulted in considerable success except in the case of the hard pines, which apparently should always be planted in the spring.

2. Slit planting resulted in good survival on heavy soils, especially in fall planting, but the growth of trees planted by the hole method was superior. Small stock planted by the slit method had poor survival.

3. Growth of trees planted in ploughed furrows was better during the first 2 years than that of trees planted in the sod.

CANADA'S forests continue to be an important source of fuel, supplying about 15 to 20 per cent of the domestic requirements of the country. During the five-year period 1931-35 the average annual cut of fuel wood in Canada was approximately 9,000,000 cords valued at about $33,000,000.

The Forest Products Laboratories and the Testing and Research Laboratories of the Department of Mines and Resources, in cooperation with other organizations, are investigating ways and means of extending the use of wood for fuel.

It has been found that as a rule the fuel value of seasoned wood depends generally on the weight per cubic foot, the heaviest woods naturally giving the most heat. A standard cord of well-seasoned sugar maple, beech, or yellow birch split firewood weighs upwards of 4,000 pounds, whereas a similar cord of softwood may weigh less than two-thirds as much. The relative value of the different wood fuels may, therefore, be approximately compared on the basis of their weights, at the same moisture contents. Two pounds of seasoned firewood are generally required to furnish the amount of heat obtainable from a pound of anthracite coal of good grade. Coal, however, is generally burned somewhat more efficiently, especially since much wood is used in heating installations designed for coal. In order to deliver the same amount of heat to a boiler as a pound of coal, a little more than two pounds of wood are required.

THE INFLUENCE OF NITROGENOUS FERTILIZER APPLICATIONS UPON SEED PRODUCTION OF CERTAIN DECIDUOUS FOREST TREES

By ROBERT F. CHANDLER, JR.
Cornell University

It has been known for some time that the application of nitrogenous fertilizers favorably affects the fruit production of fruit trees and other crop plants. Although it might have been suspected that forest trees would be similarly affected, no experimental data on this point have been available. The author shows that the application of such fertilizers increased the number of seeds produced by beech and sugar maple, but that the percentage of sound seed and the weight of individual dry seeds were increased significantly only in sugar maple. Despite the fact that these results may have little application in commercial seed production because of the relatively high cost of the amount of fertilizer applied, they nevertheless may be of considerable interest to the forest tree geneticist.

MEANS of inducing frequent and heavy seeding of forest trees are of particular interest to forest neticists, nurserymen, seed collectors, c. It is the purpose of this paper to esent experimental evidence of one way which the seed production of forest ees was stimulated.

In the spring of 1936, nitrogenous ferizers were applied to several plots a second growth, uneven-aged, sugar aple-beech-yellow birch forest on Lordswn stony silt loam soil at the Arnot orest about 18 miles south of Ithaca, . Y. Although the study was inaurated with other objects in view, in e late summer of 1937 a very heavy ed crop was observed on the fertilized ots while a light crop was apparent on e check plots. In view of the outanding observational differences, more act data were obtained as to the amount d quality of seed on the various plots.

XPERIMENTAL MATERIALS AND PROCEDURE

The experimental area was laid out in oril, 1936, in randomly distributed, uare, quarter-acre plots, with a 25-ot border strip between plots. Each rtilized plot had a check plot adjacent it. The fertilizer applications were avy being at the rate of 1,600, 3,200, d 4,800 pounds per acre of a mixture of equal parts of ammonium sulfate and sodium nitrate. No additional fertilizer has been added since the original application.

The species composition of the stand consisted largely of sugar maple, *Acer saccharum* Marsh., and American beech, *Fagus grandifolia* Ehrh. Scattered specimens of white ash, *Fraxinus americana* L., red oak, *Quercus borealis* var. maxima (Marsh) Ashe, black birch, *Betula lenta* L., and hop hornbeam, *Ostrya virginiana* (Mill.) Koch, were present. Data were secured only from beech and sugar maple because of the scarcity of individuals of the other species. The average combined number of beech and sugar maple trees over 4 inches d.b.h. on each plot was 17. The figures in Table 1 were derived from populations of that size.

A tally of all trees over 4 inches d.b.h. was made, recording whether or not the trees produced any seed and the estimated percentage of the crown which bore the seed crop. Since there seemed to be a tendency for smaller trees to produce seed on the fertilized plots than on the check plots, trees over 8 inches d.b.h. were recorded separately from those in the 4-8 inch diameter class.

In order to express the degree of seeding on each plot in a single figure, the "seeding index" was calculated. It is

simply the product of the percentage of the trees bearing a seed crop, and the average percentage of the crown bearing the seed. Therefore, the index has a maximum value of 1.00, this occurring when all trees bear a 100 per cent crop.

The above estimate, however, did not give full information as to the intensity of seeding since a light crop spread over all the branches of the tree would be recorded as 100 per cent seeding just as would a heavy crop on all branches; but it did give evidence as to what portion of the branches of the tree were producing seed.

In order to obtain more information on the degree of seeding of individual branches, several representative seeding branches were cut from the crown of each of four sugar maple trees on each fertilizer plot. The following data were secured: Percentage of total growing points which bore seed; number of seed pairs per cluster; percentage of sound seed; and weight of 100 sound seeds. The same data were secured from the check plots but since very few unfertilized trees produced any seed, it was necessary to combine all check trees, constituting a sample of 5 seed-producing trees. The soundness of the seed was determined by squeezing the seed between the thumb and forefinger, the poor seeds collapsing under the pressure. Previous experience has indicated that the seeds with firm embryos would germinate if properly after-ripened.

The seeds of sugar maple are borne in clusters at the end of the new shoots, while beech seeds are borne in the leaf axils of the new shoots. The new shoots on the beech trees in this experiment never produce more than two pairs of seed. Therefore, instead of counting the number of seeds per cluster as with the maple, the percentage of the new shoots bearing seed, and the percentage of these seed-bearing shoots that produced two pairs of seed was calculated. The soundness of the beach seed was determined b cutting the seeds with a knife. A see was considered sound if the embryo ap peared white and filled the seed. Th season advanced to such a degree durin the progress of the work that the beec nuts began to drop before four tre could be sampled on all of the 6 plot Therefore, the data for the fertilized plo were combined, and compared with th combined data from all check plots. Si fertilized and 6 check trees were used i the comparison.

Results Obtained

Data showing the percentage of tre bearing seed, with the average percen age of the crown of each seed-bearin tree that produced the seed crop, as we as its seeding index are reported Table 1. This latter value is the be indicator of the amount of seed produc since it takes into consideration both t frequency of the seed-bearing trees an the amount of seed produced by ea bearing tree.

Considering the data for beech we s that there were not any great differenc among the fertilized plots. When t various fertilized plots were compar with their adjacent check plots, some i portant differences were apparent. W the exception of the percentage of tre bearing a seed crop in the case of t 4,800 pound plot, all trees over 8 inch d.b.h. on the fertilized plots exceed their check plots by a considerab amount in both frequency of seed be ing trees, and intensity of seeding of t individual trees. The seeding index fertilized plots was greater in all ca than that for the check plots, this crease ranging from 133 to 647 per ce

In the case of beech trees 4-8 inc d.b.h., the differences between fertili and check trees were of similar mag tude to those of the trees over 8 inc d.b.h. The percentage increase of seeding index over the check plots w

33 for the 3,200 pound application and)0 for the 4,800 pound application. he increase for the 1,600 pound plot as infinite since none of the check trees roduced any seed.

The effects of nitrogen applications pon the intensity of seeding in the case sugar maple were much greater than ith beech. All trees over 8 inches b.h. on the fertilized plots had seed, hile the percentages for the check plots nged from 12.5 to 25 per cent. In adtion, none of the trees in the 4-8 inch ameter class produced any seed on the eck plot, while 75 to 100 per cent the fertilized trees of the same diameter nge produced a seed crop. The intensity seeding on the individual seed-proicing trees also showed marked differces. The seed crop for the fertilized ees over 8 inches d.b.h. was spread er 90.0 to 97.6 per cent of the crown, hile only 10 to 25 per cent of the owns of the check trees bore a seed op. The differences in seeding index owed an average percentage increase r fertilized plots over check plots of 040 per cent.

In Table 2 are presented the data for e intensity of seeding of the individual ed-bearing branches of beech. The andard error of the mean was calcuted, from which the standard error of e difference was obtained. The statiscal calculations were corrected for small imbers since only 6 determinations ere used in obtaining the mean values. the difference between two means exeded two standard errors, the odds ere greater than 19:1 that the difference as not due to chance alone. Such differces were deemed significant.

A significantly greater number of the w shoots bore seed on the fertilized ots, and in addition a greater number the bearing shoots bore two pairs seed. There was no significant difference between the fertilized and check ots with respect to the soundness or ight of seeds produced.

TABLE 1

EFFECT OF NITROGENOUS FERTILIZERS UPON SEED PRODUCTION BY BEECH AND SUGAR MAPLE TREES

	Range in d.b.h. Inches	Beech						Sugar maple					
		Fertilizer application[1] in lbs. per acre											
		1600	Check	3200	Check	4800	Check	1600	Check	3200	Check	4800	Check
Percentage of trees bearing a seed crop	4-8	100.0	0.0	33.3	50.0	100.0	66.6	75.0	0.0	100.0	0.0	100.0	0.0
	Over 8	100.0	57.1	100.0	66.6	100.0	100.0	100.0	20.0	100.0	25.0	100.0	12.5
Percentage of crown of seed-producing trees bearing seed crop	4-8	40.0	0.0	80.0	20.0	60.0	22.5	63.3	0.0	90.0	0.0	59.3	0.0
	Over 8	85.0	63.9	87.5	17.5	90.0	19.0	97.6	25.0	95.1	10.0	90.0	20.0
Seeding index[2]	4-8	0.400	0.0	0.266	0.100	0.600	0.150	0.475	0.0	0.900	0.0	0.593	0.0
	Over 8	0.850	0.365	0.875	0.117	0.900	0.190	0.976	0.050	0.951	0.025	0.900	0.025

[1]Fertilizer application consisted of a mixture of equal parts of ammonium sulfate and sodium nitrate.
[2]Seeding index is the product of the percentage of trees bearing a seed crop and the average percentage of the crown bearing the seed crop.

In Table 3 are presented similar data for sugar maple. As compared with the check trees, each fertilized plot had a greater percentage of the growing points bearing seed clusters, which, in addition, produced a greater number of seeds per cluster. Furthermore, these seeds were of better quality and larger size. All of the differences were statistically significant (odds in excess of 19:1) except the percentage of sound seeds on the 3,200 pound application. In this case the odds were 18:1 that the difference was not due to chance alone.

The statistically significant differences among the various fertilized plots were as follows: The percentage of growing points bearing seed was greater on the plot receiving 1,600 pounds of fertilizer than on the plot receiving 3,200 pounds, and the dry weight of the seeds was less. The 4,800 pound application produced significantly heavier seeds than the 1,600 pound application.

Interpretation of Results

The reason for this seeding response to nitrogen fertilizer applications is not known. The leaves on the check trees were relatively small and of a light green color, while the fertilized trees had large, dark green leaves. The growth rate of the fertilized trees was stimulated. These responses were visible by the latter part of June during the first growing season after the fertilizer was applied. The total nitrogen content of the foliag of trees on the fertilized plots in Sep tember, 1936, expressed as percentag of dry weight, averaged 2.73 for beec and 2.98 for sugar maple. The chec plots averaged 2.03 for beech and 1.5 for sugar maple.

In view of these differences, the seed ing response may have been a result o certain compositional changes in car bohydrate and nitrogen contents producin results in accordance with the theor originally proposed by Kraus and Kray bill.[1] It is outside the scope of thi paper, however, to discuss the theoretica causes involved. It has long been note by various horticulturists that addition of nitrogen to soils deficient in this ele ment resulted in increased growth, flowe bud formation, and fruit set. The cause whatever they may be, probably are sim lar whether sugar maple or apple tree are involved.

The fact that the differences in seed pr duction between fertilized and chec sugar maple trees were much great when the smaller trees were compare is rather an important result. Becau the trees were smaller does not nece sarily follow that they were younge Increment borings of certain of t trees indicated, however, that the youn est seed-producing tree on the fertiliz plots was 24 years old, while the youn est one on the check plots was 46 yea of age. Nevertheless, certain of t

Table 2

INTENSITY AND QUALITY OF SEEDING ON BRANCHES OF BEECH TREES AS AFFECTED BY NITROGENOUS F TILIZER APPLICATIONS

	Average of fertilized trees	Average of check trees	Difference with its standard error
Percentage of new shoots bearing seed	71.51 ± 10.08	29.66 ± 7.58	41.95 ± 12.61
Percentage of seeded new shoots bearing two pairs of seeds	19.60 ± 4.47	7.51 ± 2.65	12.09 ± 5.19
Percentage of seeds that were sound	89.60 ± 3.42	84.79 ± 1.83	4.81 ± 3.88
Oven dry weight in grams of 100 sound seeds	24.79 ± 1.43	26.51 ± 0.91	1.72 ± 1.69

[1]Kraus, E. J. and H. R. Kraybill. Vegetation and reproduction with special reference to tomato. Oregon Agr. Exp. Sta. Bull. 149. 1918.

TABLE 3

INTENSITY AND QUALITY OF SEEDING OF SUGAR MAPLE TREES FROM FERTILIZED AND CHECK PLOTS

	Check	Application of nitrogenous fertilizer in pounds per acre					
		1600		3200		4800	
	Mean with its standard error	Mean with its standard error	Difference from check with its standard error	Mean with its standard error	Difference from check with its standard error	Mean with its standard error	Difference from check with its standard error
Percentage of growing points bearing seed clusters	58.3±11.01	98.4±0.73	40.1±11.02	91.5±2.87	33.2±11.4	94.5±1.52	36.1±11.15
Average number of seed pairs in each cluster	3.25±0.39	5.75±0.87	2.50±0.95	4.95±0.47	1.70±0.61	4.99±0.46	1.74±0.60
Percentage of seeds that were sound	44.5±0.98	50.8±0.53	6.3±1.11	54.7±5.29	10.2±5.38	54.7±4.76	10.2±4.86
Oven dry weights in grams of 100 sound seeds	5.53±0.26	6.32±0.032	0.79±0.26	6.87±0.12	1.34±0.28	7.68±0.46	2.15±0.52

trees in the 4-8 inch diameter class were just as old as some of the trees that were over 8 inches in diameter. Therefore, the nitrogenous fertilizer increased the seed production of not only younger trees but also trees in the smaller crown classes. Examination of the twigs of the maple trees less than 8 inches in diameter revealed that the majority of them had never produced any seed before.

The fact that this relationship was more pronounced with the sugar maple than with the beech seemed to be characteristic of the species involved. The beech trees on the check plots bore a small amount of seed in the top of the crown. Since the age at which a tree bears the first seed crop and the frequency with which successive seed years occur, is characteristic of the species involved, it is impossible to propose definite recommendations for all species under all circumstances. On the other hand, since fertilizer applications have influenced the production and quality of seed from beech and sugar maple trees, a similar procedure would seem worthy of trial for any forest tree species.

The influence of the fertilizer applications upon the viability of the sugar maple seed may have been the result of a greater nitrogen supply during the pollination period. Horticulturists generally agree[2] that a high nitrogen content in the soil is conducive to fruit setting in the case of the apple.

The reasons for a lack of seed quality response in the case of the beech can only be conjectured. The soundness of the seed from the check plots was high, so less room for improvement existed. The beech trees on the check plots seemed to exhibit an inverse correlation between number of seeds per tree and size of individual seeds. Therefore, large seed crops on the fertilized trees may have had a tendency to reduce the size of the individual seeds.

[2]Chandler, W. H. Fruit growing. pp. 182-185. Houghton Mifflin Company. New York. 1925.

In considering differences among the plots receiving various amounts of fertilizer, it is evident that no consistent trends were present, although certain of the differences were statistically significant. Since the lowest application gave as satisfactory results as the highest one, these data alone do not give evidence as to the lowest amount of nitrogen that would give a satisfactory seeding response. In consideration of other studies on the absorption and utilization of nitrogen by forest trees, however, certain general recommendations can be made.

The amount and kind of nitrogenous fertilizer to apply would, of course, vary in accordance with the soil type and tree species. Under most circumstances about 1,600 pounds per acre of sodium nitrate the first year followed by 1,000 pounds per acre each successive year would seem adequate. The reason for the heavier application the first year is that trees which have been growing on a nitrogen deficient soil can absorb and utilize a larger amount of nitrogen the first year than would be possible afterwards. Sodium nitrate rather than ammonium sulfate is suggested since the latter fertilizer tends to produce an acid soil condition which might in time become harmful.

There is a great need for studies along these lines with coniferous trees. It may be that similar results would not be obtained. Also smaller amounts of nitrogen in the ammonium form might prove more satisfactory since many soils supporting a coniferous forest do not readily nitrify.

Summary

This paper reports the influence of nitrogenous fertilizer applications upon the production and quality of seed by beech and sugar maple trees growing in a mixed, second growth, uneven-aged hardwood stand near Ithaca, New York.

The fertilizer applications resulted in a very significant increase in the total number of seeds produced by both beech and sugar maple trees, although the stimulation was greater in the case of the sugar maple.

The percentage of sound seed and dry weight of individual seeds were increased in the case of the maple, but beech exhibited no significant differences.

Although these data represent only two species, the results were so outstanding that it seemed important to bring them to the particular attention of foresters who are interested in stimulating the seed production of specific but relatively few trees.

THE ENCOURAGEMENT OF PRIVATE FORESTRY IN THE STATE OF NEW YORK[1]

By T. F. LUTHER
Luther Forest Preserve

MANY years association with the New York Section's Committee on Forest Policy and Legislation ave led me to believe that the solution f New York's important land use probem lies in encouraging the practice of rivate forestry.

The state's present conservation plans ontemplate the acquisition of more than ne-third of the entire land in the state. ecause many of us believe that the enouragement of the business of forestry s vitally important to the State of New ork, the Committee scrutinizes with anxety the state's proposed program of forst land acquisition; it questions the wisom of the state's proposal to engage in ndustrial forestry. Furthermore it beieves that the state has not encouraged rivate forestry to the extent that it hould. This Committee also believes that ociety will reap a more lasting benet by encouraging private rather than ublic forestry.

For these reasons the Committee proposes corrective and constructive legislaive measures, which it believes will enourage the retention (in private ownerhip) of the forest lands that are best uited to forestry and that have a fair hance of being managed successfully. s a result, the labor and communities ependent upon the forest resources will e stabilized, and the health, welfare, omfort and safety of the people of the tate greatly enhanced.

The Business of Forestry

For our purpose the business of forstry may be defined as that occupation which can gainfully employ labor in the preservation of private forests by wise use, and the development and utilization of forest lands based on sound principles of sustained yield management. Therefore the words private and industrial forestry, as herein used, are synonymous with the business of forestry.

The problem of forest taxation, which has not yet been solved, is regarded by private forest owners as one of the great barriers to private forestry. Even the Fairchild *Report on Forest Taxation* did not suggest a definite solution.

Growing trees are still considered realty as shown by the following definition of real estate from the New York State Tax Law. The term real estate includes, "all trees and underwood growing upon the land." As we view the business of forestry, we do not contemplate the growth of trees in a wild state. Rather do foresters hope to improve upon nature by the application of good forestry principles and practices. Under these conditions growing trees can no longer be considered anything but a growing crop. Therefore it is recommended that the foregoing provision of the Tax Law be deleted; or as an alternative that it be confined and limited to lands *not* under forest management. R. C. Hall, head of the Forest Taxation Inquiry, is of the opinion that this recommendation is entirely feasible in the State of New York and that the loss of revenue to the state would be so negligible that its tax structure would hardly be affected. Such legislation would not only forever remove forest growth from the vagaries of the local tax assessors; but would free

[1]Presented at the winter meeting of the New York Section, Albany, N. Y., Jan. 26-27, 1938.

the tree crop, the same as farm crops, from the annual property tax. For these reasons such legislation may be considered the foundation of the business of forestry.

Free of an annual property tax, forest crops could grow to a financial maturity whose worth will be far in excess of any forest valuation possible under the present tax system. The following pertinent question can now be raised, if a forest owner pays only a nominal annual tax on the land, in what manner would he share in the expense of government? The answer is, he would receive a much larger income from a well-managed forest; and, therefore, would have to pay a larger income tax.

The rural regions are the principal source of forest labor. Although work of rural laborers for part of the season is primarily agricultural, yet if a private forest owner should hire them he would be immediately subject to the provisions of the Workmen's Compensation Act. Substantially the same work done by farm laborers is now specifically exempted by the statutory definition of the word "employee" as found in this act. Therefore it is recommended that the exemption extended to farm laborers under Section 2, subdivision 4, of the Workmen's Compensation Act be extended also to include forest laborers.

If a farmer harvests and transports his own timber, he need not pay workmen's compensation insurance, provided he does not employ more than four persons at one time. No logical reason exists why this should not be applicable to a person engaged in the business of forestry. The conception that timber is property similar to coal in a mine is no longer in accord with the facts. Timber must be grown like any other crop. For this reason it is suggested that Section 3, subdivision 1, group 18, of the foregoing act be extended to provide that persons employed in harvesting a crop of timber by a forest owner on his own holdings shal not be deemed to be employed or engage in employment under this section, provided that not more than four persons ar so employed by such forest owner at on time, and provided further than this exemption shall *not* extend to the sawing o such timber or wood into lumber.

The measures in the Workmen's Compensation Act exempting agricultural labor is an outstanding example of th policy of our state in agriculture. A similar policy towards private forestry is nov wanted from the State of New York.

The State of New York is not indifferen to its land use problem. This interest i expressed in Article 7, Section 16, of th Constitution, which contemplates the pur chase of one million acres of idle land for reforestation purposes and authorize the state to enter the forestry busines Nothing short of a Constitutional amend ment was necessary for the enabling pro visions, the details of which are worke out under Section 60a of the Conservatio Law. Thus was the business of forestr made part of the fundamental law of ou state, confined though it may be to par ticular public holdings. Here is where a courageous legislature could well ha solved this problem by fundamental legis lation that would encourage the busine of forestry on private and idle lands our state. Now the state is asked not extend for the moment its activity, und the present reforestation law, until it h exhausted the possibilities of reforestati through private means. If private forest succeeds, the state will be relieved im mediately of the outlay of not only huge capital investment, but also annu administrative and maintenance cos Furthermore it will gain a prospect source of revenue, which otherwise w be irretrievably lost. It will leave private enterprise a field never intend for governmental activity. Therefore constitutional amendment to be known Article 7, Section 16 B, under the pres

forestation law, is recommended, which ll contain words substantially, as follws: "that the proper development of e forest and idle lands of our state in ivate hands, is a matter of public inest, and is a worthy subject for instigation and encouragement by the ite, for the welfare of its inhabitants."

Strange as it may seem, no definitions the words conservation, or forest conrvation, appear among some 79 defitions found in the index of our Conrvation Law. Although under Section a of this act the Conservation Department is charged with the specific task of forestation, no definitions will be found this law of the words forestry or fortation. Perhaps this oversight is not ely to be harmful, since the College Forestry or the forestry profession can depended upon to define their standds. That is not true, however, of the ord "conservation," although linguists d writers ofttimes have loosely used ese words synonymously. As Dr. Joseph Illick points out "conservation means hold, reserve, preserve and has come mean a wise use, although where delopment has been associated with it, e latter has little meaning."

Although the business of forestry prooses conservation through wise use, reacement through development, managent and utilization, it should not find elf subjected to the stress and strain of ery extremist in conservation. Otherse, it runs the risk of some day finding superstructure "gone with the wind." r this reason statutory definitions of restry, forestation, conservation and fort conservation, in accordance with the orementioned opinion, should be includ in our Conservation law.

Since in our concept of forests the word siness has been stressed, it may be well ascertain in general, from what sources, e business of forestry can sustain itself.

Recreation facilities offered the year und to persons of average and underaverage incomes at prices that they can meet, opens up a source of revenue. Some idea of the size of this income can be estimated from the ever increasing demand made for the meagre facilities now available in our forest region.

The number of edible mushrooms growing each year on one forest area has attracted many persons, who simply help themselves. One private forestry company leases berry picking privileges which in some years returns $50 or more per specified area. In general, private forest lands constitute free parks for our people.

The once large income obtained from pelts could be restored by proper forestry practices and game management and placed on a sustained yield basis.

The maturing of the stands in the statutory preserves has caused deer to seek food on the lowlands where browsing is good. This may also be true of other game and wildlife. Thus the income from deer and game hunting is appropriated by the state, although they are raised and to a considerable extent hunted on private lands. It is our opinion that private forests should receive a share of this income, commonly called a hunting license, charged for the privilege of gathering the crop.

While the growth of trees for all purposes, would be a long term investment, some annual income could be obtained through the sale of duly certified forest seeds, as well as the sale of small trees for nursery and landscaping uses that are now destroyed by thinnings.

By no means do these exhaust the possible sources of income from this industry. They are mentioned only to show the possibilities to private endeavor, if these lands are retained in private ownership.

Other Corrective Measures

Other desirable corrective and helpful measures may be mentioned. Section 200 of the Town Law, might be amended so

as *not* to make mandatory the erection of a common fence between two adjoining forest owners, nor in areas predominantly forests.

Section 13 of the Tax Law, has failed to accomplish its avowed purpose. The deferred yield tax provided in this act should be eliminated because forest growth is considered the same as other crops. Furthermore the term "idle lands," as used in this act, should be clearly defined.

Forest and idle lands should not ordinarily be assessed at a higher value than cut-over lands, which apparently are procurable at figures considerably less than $4 per acre. We suggest that there be devised an inexpensive and quick method of arriving at tax values as, for example, the method used by fence viewers.

Lands on which sustained yield forest management is practiced should have available ready financial assistance at a low rate of interest. With forest fire insurance promising to be a reality at a reasonable premium and with this insurance as added security, it should be possible to extend Federal Land Bank loans to forest lands. In a measure these provisions are already operative, since farm woodlots are included in loans and these constitute a large share of our available timber supply in New York.

At the present time 50 per cent loans are made at an interest rate of 2 per cent to farmer cooperatives on their produce. This provision should be extended to include cooperatives for manufacturing and marketing forest products.

The Forest Revolution

The owner who will go into this business must necessarily be a pioneer. He must have an appreciation of the devotion of our forest and idle lands to proper forestry practices, not only for the opportunity for a livelihood or immediate gain, but also to every reasonable social consideration. We think that such a person will evolve, from this proposed fresh ve[...]ture into cooperation, between busine[...] and government. This is the individu[...] who must be encouraged to possess o[...] forest and idle lands, unto himself a[...] his successors, for he will solve our la[...] use problem.

The argument is usually advanced f[...] public acquisition of land that thereb[...] permanency of ownership and policy [...] better established, but we can look [...] Russia with three distinct forms of go[...]ernment within a period of twenty yea[...] and Germany with a similar number [...] changes within the same length of tim[...] These changes with their various scho[...] of thought mean marked changes in poli[...] governing forests and land use. Is th[...] stability, or does permanency depend [...] the individuals within a nation?

It is our earnest wish that any pr[...]posals that are made shall not be tak[...] as propaganda which would tend to p[...] emphasis on only one part of the pl[...] but we ask that the matter be taken a[...] whole and weighed, and that the propos[...] be regarded critically in the light of [...] selfish purpose.

Private forestry has retreated psyc[...]logically as public acquisition and acti[...] have increased in our state, that is, [...] private owner of forests and fores[...] lands, and those best suited for foresta[...] have become increasingly pessim[...] about the future advisability of grow[...] timber crops and making use of their [...]ests for other purposes, in competi[...] with the state owned properties.

To make effective a declaration of s[...] a forest policy as has been proposed, [...] urge the creation of a Division of Pri[...] Forestry, either in the Department [...] Agriculture and Markets, since forestr[...] the federal government is under the [...]partment of Agriculture, or if it se[...] advisable, in the Conservation Departm[...]

It seems advisable, since this div[...] may well become one of the most im[...]tant in New York, concerned as it wi[...]

th the welfare of one-third of the land ea of the state, to take the utmost care the choice of its personnel, which in l events should be under civil service. is, of course, at least in the beginning, sential that this division have an ad- sory committee composed of men who ve shown a true interest in the vitality private forestry. From the beginning e ultimate goal of this division should sustained yield forest management, im- ediately attainable in some sections of e state, and no doubt practical for the tire forested area within a comparatively ort period.

The first task should be a forest stock king of the entire state, preferably by rial survey, which has many marked vantages. These maps would naturally of invaluable use in the whole taxation ucture. In one county alone it has been ablished from a study of the assessment lls that the total acreage assessed is 15 r cent less than the actual land area of e county. These maps and surveys ould be taken by townships for all the ral areas in the state and should estab- h the extent of each property by indi- lual ownership. It has been estimated the best available data that there are 0,000 such owners. It may be possible ough the federal Forest Survey to com- e the growing stock for the entire state individual owners.

This Division of Private Forestry should set up county units rapidly. The nucleus of such a staff is already available in the Conservation Department's district foresters.

The success of this plan may well rest on the necessary enlargement of educational and extension work. The men and institutions already engaged in this work should be most valuable. In agricultural counties the farm bureau agent should be of great assistance.

So much experimental work has been completed or is in progress that our proposed Division of Private Forestry would have a large amount of material upon which to establish a department of the utmost usefulness to our citizens. From this material we should gain a keen appreciation of the cooperative and experimental efforts of federal, state and private agencies.

These proposals may also mark a forest revolution in that we ask a marking of time in state acquisition of lands. The psychology of the day would seem to tend to a belief that governments alone cannot solve our problems, but rather that through cooperation with private land owners can any lasting good be accomplished.

We who live today are moved by a deep desire to leave a heritage for future generations. How better can this find realization than through the betterment of private property by cooperative effort?

COMMENT

By WM. G. HOWARD
N. Y. Department of Conservation

MR. LUTHER has made several recommendations of steps that should be taken to promote the practice of forestry on privately owned land. As I read his paper, these steps may be summarized as follows:

1. Do away with all taxation of growing timber. Provide for equitable taxation of the land which is to be assessed by some other agency than the local assessor.

2. Exempt small forestry operations employing not over four men from the requirements of Workmen's Compensation Insurance.

3. Abandon the state's enlarged reforestation program.

4. Exempt the forest owner from the fencing laws which now apply to him the same as to other landowners.

5. Provide financial aid to the private timber landowner at a low rate of interest.

6. Create a division of private forestry in the State Department of Agriculture and Markets with an advisory committee of "men who have shown a true interest in the vitality of private forestry." This division of private forestry should take a forest inventory, preferably by an aerial survey; it should set up a field office in each county for the encouragement of private forestry; it should work for the "enlargement of educational and extension work" in forestry.

In the course of the paper, Mr. Luther discusses these various questions in detail. He starts out by saying: "We question the wisdom of the state's proposal to engage in industrial forestry." I assume this refers to the carrying out of the enlarged reforestation program which as at present set up, calls for the acquisition by the state of one million acres of abandone farm lands and the administration those areas as state forests. Mr. Luth also states definitely that the state's lar acquisition should be discontinued.

It is difficult for me to see how th acquisition of abandoned farm lands the state is in competition with any oth agency. The owners of these lands a in no position themselves to reforest an operate the lands, nor has any priva agency sought to acquire these lands any large scale. If it were, we would n be able to acquire them at less than per acre as we are now doing.

Mr. Luther's proposal that growing ti ber be not taxed amounts in effect to su sidizing the timber landowner for the pr duction of timber. Whether this is sirable is not an economic question. personally, while appreciating the des ability of enabling the timber landown to pay his tax at the time he gets his turn from the timber, question wheth we are justified in exempting him fr taxation on that timber.

Mr. Luther's proposal for a scient method of assessing the land itself is, course, theoretically desirable; but I qu tion whether our present system of ass ment can be altered for a long time come.

Mr. Luther's proposal that small estry operations employing not over f men be exempted from the application the Workmen's Compensation Law in same manner as agricultural operation a like nature is, I believe, deserving consideration, although the number men involved is so small that I ques whether such exemption would have great effect on our general program private forestry in the state.

You would not expect me to favor the oposal that the state abandon its en-rged reforestation program, nor does it em to me that such a proposal will et with general approval within the te. The reforestation program has been proved by various groups, by the State anning Board, and by individuals in all lks of life who realize the necessity of tting to profitable use the millions of res of abandoned farm land that exists our state today. The federal govern-ent and most of the states who have any d of a forestry program are building and operating publicly owned forests. e U. S. Forest Service in its so-called peland Report has approved such a ogram. I personally feel that it will far towards stabilizing forest land own-ship and promote the practice of sus-ned yield in forest management, as well affording a demonstration of the pos-ilities of the practice of forestry.

The exemption of the forest owner from cing laws that apply to agricultural ners is probably in most cases a matter small moment. It is probable that lack such exemption is not a great deterrent the practice of forestry on privately ned lands.

Financial aid to private timber land-ners at a low rate of interest is highly sirable. I can see no reason why the ber landowner should not be entitled the same type of credit facilities as are orded the farmer by the Federal Land nk. Moreover, as a member of the ecutive committee of the Forest Con-vation Conference called by the lumber lustry a few years ago, I consistently vored the forest credits legislation rec-mended by that Conference.

As to the creation of a division of pri-te forestry in the Department of Agricul-e and Markets, while I favor the reten-n of the U. S. Forest Service in the S. Department of Agriculture, the his-y of the development of our own Conservation Department has been so different from that of the U. S. Forest Service that I feel all forestry activities should be retained within the State Conservation Department. If the carrying on of forestry activities within the Conservation Department is not satisfactory to the private timber landowners, the matter should be taken up with the Conservation Commissioner. On the other hand, if there is to be a division of private forestry, it should definitely be in the Conservation Department and not in the Department of Agriculture and Markets. While I have never discussed this matter with the Commissioner of Agriculture and Markets, I rather believe he would agree with this premise. As to the things proposed to be done by the division of private forestry, I think we are all agreed that a forest inventory is highly desirable. I hope we can get such an inventory, and I have recently been corresponding with the U. S. Forest Service to see whether we cannot hasten the bringing of the federal Forest Survey to this state. I have also long favored an aerial survey of the state, as suggested by Mr. Luther.

When it comes to setting up county forestry units, I can see that in the future, as we have an extension of state forest ownership, we may want units smaller than the present forest districts, but it is questionable in my mind whether we want to operate on the basis of a unit as small as a county.

As far as the enlargement of educational and extension work is concerned, I think all of us are in favor of that.

Mr. Luther has said that the state should not extend its activities under the present Reforestation Program until it has exhausted the possibilities of reforestation through private means. When we started the Enlarged Reforestation Program in 1929 we felt we were doing so upon the basis that we had offered all possible encouragement to private industry to re-

forest the idle lands of the state but that with all that encouragement, only about 25,000 acres per year were being reforested. Mr. Luther makes a good deal of the investment of the state in its reforestation program. I sincerely hope that as our management of these state forests proceeds, we will be able to return this investment with a profit to the taxpayers of the state.

I am not anxious to see New York State go further than it should in state ownership and operation of forest lands. On the other hand, it seems to me fairly obvious that our state should own and administer a large area of forest. In the first place, our park system, including the Forest Preserve, takes in about two and one-half million acres. If these lands are not owned and administered by the state for recreation, watershed protection and other public purposes, what agency can we call upon to do this job? Certainly the private owner is not willing to operate his own lands under state regulation to provide for the public interest in recreation and watershed protection. As to the other class of state forest lands, present or potential, namely, the state forests that are being built up on abandoned farm lands, there would seem to be no possibility of private initiative tackling this problem.

Mr. Luther has made the statement that nothing short of a constitutional amendment was necessary for the setting up the reforestation program. That is n strictly true except so far as it concer that part of the program which is with the Adirondack and Catskill Forest Pr serve counties but outside of the parks.

It is not clear to me what can be mea by Mr. Luther's suggestion that the should be "fundamental legislation th would encourage the business of forest on private and idle lands of our state."

I am anxious for our Conservation D partment to give as much help as it ca properly to further the practice of forest on privately owned lands. I submit th we are already giving more assistance the private forest owner than are ma of the other states, through a reasonab effective forest fire control system a through reasonably equitable taxation. the latter were not true, we would u doubtedly have more applications f classification of lands under the Fish Forest Tax Law. Provision for the c tribution of forest trees produced in st nurseries and sold at cost of product is also a benefit which the timber la owner of New York State enjoys.

All in all, it seems to me our state offering as much encouragement to practice of forestry on privately ow lands as is nearly any other state. U doubtedly we can increase this assista to private landowners gradually and methods in accordance with our statu

HE MAGNITUDE AND REGIONAL DISTRIBUTION OF WATER LOSSES INFLUENCED BY VEGETATION

By JOSEPH KITTREDGE, JR.

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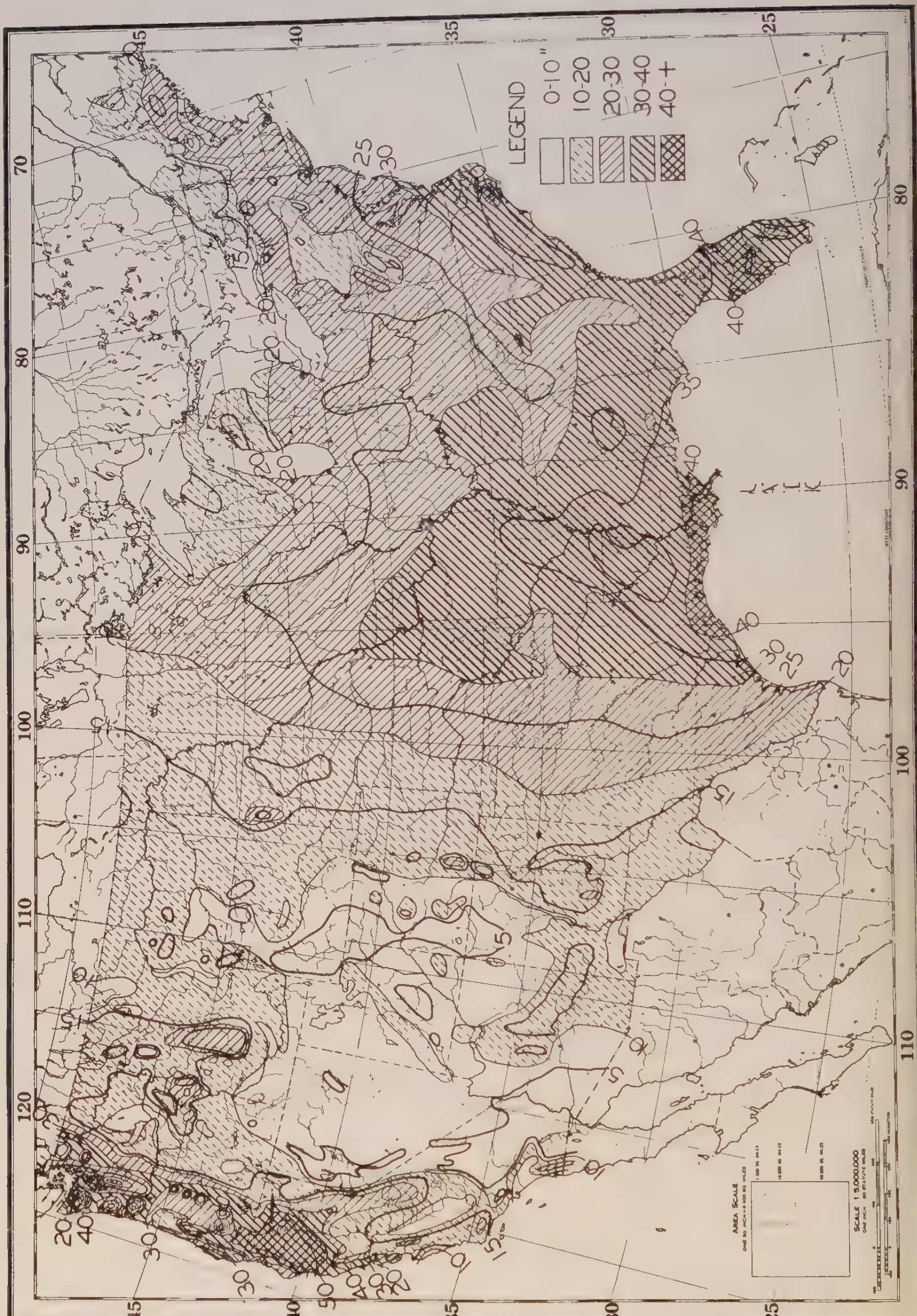
The fact that forest and other vegetation cause or influence losses of water from soil and eventually from streams is well-known, but the magnitude of those losses in the different forest regions has been less known than its importance would justify. With information now available, these losses can be evaluated for the United States, and it seems worth while to contribute something to an understanding of their amount and distribution.

AN isohyetal map of mean annual precipitation has been published by the Weather Bureau (3) and re-
ntly a revised but still preliminary map
owing lines of equal mean annual run-
 based on some 3.000 records of stream-
w has been made available by the Na-
nal Resources Board. (1) According
the equation of the water cycle, by sub-
icting the runoff from the precipitation
corresponding locations, figures are ob-
ned for the sum of the water losses
used by transpiration and interception
the vegetation, evaporation from the
il and seepage into the rock strata which
es not reappear as streamflow. The loss
seepage is negligible except in locali-
s of permeable rock, so that in most
ices the results represent substantially
losses influenced by vegetation. The
ferences between precipitation and run-
were computed for each intersection of
rallels of latitude and longitude by two
gree intervals and for those points
ere records of both precipitation and
noff were available at identical stations.
fferences at intermediate points were in-
ted where gradients were steep. Lines
equal annual losses in inches of water
re then drawn with the result shown on
map, Figure 1.[1]

In matters of water yield and supply,
runoff map gives the needed informa-
n, but for the forester who is con-
ned with minimizing the losses by vegetation the map of Figure 1 provides a picture directly applicable to his problems. The map is of course no more accurate than the basic data from which the precipitation and runoff maps were drawn. It is generally admitted that the precipitation records are meager and insufficient in most forested mountainous areas. Similarly the streamflow records are by no means complete or uniformly distributed. Consequently the map of water losses will certainly be subject to revision as more data become available, and particularly in the more remote and inaccessible areas where records are infrequent or lacking.

Examples of inadequate records may be seen on the map around some of the higher mountain peaks, particularly in the West, where the water losses decrease with increasing altitude even to the point in one or two cases of becoming negative, i.e., the runoff exceeded the precipitation. Some of these instances may be not wholly a matter of inadequate records, but of actual diminished losses as the vegetation is reduced or eliminated near or above timberline. Moreover, in areas of limestone, sandstone, lava, or permeable glacial deposits, the indicated losses will be too high to be attributed exclusively to transpiration, evaporation and interception. The amount of these seepage losses is indicated for Wisconsin streams by Foster. (2) The average annual runoff

[1]The help of M. K. Goddard and A. Mazurak is gratefully acknowledged in the preparation of map.



in United States in inches

om areas of crystalline rocks was 13.1 ches as compared with 10.3 inches from eas of sandstone and 9.4 inches from eas of limestone. The differences of 8 and 3.7 inches were ascribed to seepge into the sedimentary strata. Notwithanding the weaknesses, the map adds apreciably to an understanding of water sses in different parts of the country.

The map is shaded to segregate zones water loss. Each zone covers a range 10 inches. The darkest shading repsents the highest loss. The ranges of ss in descending order of magnitude are own in Table 1 for the different regions the country as characterized by the rest vegetation.

The water losses are in general distinct r the larger forest regions and they also ow some interesting trends. In the ast, the southern pine region, including e river bottom hardwoods, has the highst losses, of more than thirty inches anually. The oak-chestnut-yellow poplar, k-hickory, and the tall grass prairie of e Central States fall together in a zone ith twenty to thirty inches annual loss. he oak-pine of the Piedmont forms a ansition in water losses, as it does in eographic location. The northern pine nd northern hardwood region occupy a ne with fifteen to twenty inches loss, d the northern spruce-fir region shows from ten to twenty inches. The regions thus form a series in which the losses are at a maximum in the South, where the temperatures are highest and the growing season longest, and in which they decrease progressively toward a minimum in the North. In general the order of the losses of the different types follows the same sequence as that of the growth rate of well-stocked forest stands. In this series of eastern types, the southern pines have the most rapid growth, and the spruce-fir the slowest, the other types occupying intermediate positions. One possible exception is in the case of white and jack pine, of which the growth rate would justify a position higher in the scale than is indicated by the annual losses. However, it may be suggested that the pine areas in recent years in the North are very poorly stocked and slow in growth, so that the water losses may be low for that reason, or because of deep seepage through the deep porous glacial deposits.

The western part of the country is divided from the eastern, as it is in so many natural phenomena roughly along the hundredth meridian by the line of twenty inch annual loss. However, in the West the progression from south to north is seriously disturbed by the low precipitation which prevails over much of the region and strictly limits the losses.

TABLE 1

ANNUAL WATER LOSSES IN DIFFERENT FOREST REGIONS

Eastern regions	Annual losses Inches	Western regions	Annual losses Inches
Longleaf-loblolly-slash pine	30-40	Pacific Douglas fir	25-60
River bottom hardwoods and cypress	30-40	Redwood	25-55
Oak-pine	25-35	Sugar and ponderosa pine	15-40
Oak-chestnut-yellow poplar	20-30	Western larch-western white pine	15-20
Oak-hickory	20-30	Spruce-fir	10-20
Tall grass	20-30	Ponderosa pine	10-20
Birch-beech-maple-hemlock	15-20	Short grass	10-20
White-red-jack pine	15-20	Lodgepole pine	10-15
Spruce-fir	10-20	Pinon-juniper	5-15
		Chaparral	5-15
		Sagebrush	5-10
		Desert shrub	4-10

Nevertheless the forest regions again fall in distinct groups. The Douglas fir and redwood of the north Pacific coast have the highest losses, of over twenty-five inches. The sugar and ponderosa pine and the western larch and western white pine of the Sierra Nevada and the northern Rocky Mountain regions respectively come second. The spruce and fir of the higher altitudes, the pure ponderosa pine, and the short grass plains, all have losses of ten to twenty inches. Lodgepole pine is slightly less, with ten to fifteen inches. Pinon-juniper and the chaparral occupy a zone with losses from five to fifteen inches, and the sagebrush and desert shrubs have usually less than ten inches.

For the forest types, this progression from higher to lower water losses is again the progression from more rapid to less rapid growth, whether the differences in growth are limited by altitude and temperature or by deficient moisture.

It is also interesting to notice that analogous types in the East and West show corresponding losses. Thus, for example, the spruce and fir types in both parts of the country occupy territory where the losses range from ten to twenty inches. The red and jack pine of the East are in the same group as to annual losses with the ponderosa and lodgepole pine of the West, and the southern pines fall in the same group as to water losses with the Douglas fir and redwood of the northwest coast.

In the foregoing discussion it should be understood that the forest vegetation is not the only cause of the losses. There will be losses by evaporation where vegetation is wholly absent, and there will be loss by deep seepage into the rock strata which reappears in other drainages or in the ocean, which is wholly independent of the vegetation. The magnitude of the losses does, however, set an upper limit for the sum of the losses by transpiration, interception and evaporation for the different regions not heretofore available and also provides interesting evidence as to the comparative water losses between regions. Finally, these figures of water loss, representing the differences between precipitation and runoff and hence the sum of the "evaporative" processes, may prove to be at least as valuable as the precipitation-evaporation ratio (4, 6) or the precipitation-saturation deficit quotient (5) as an index for correlation with the distribution and growth of vegetation.

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LIGHTER CUTS AND LARGER YIELDS IN PONDEROSA PINE

By G. A. PEARSON

Southwestern Forest and Range Experiment Station[1]

Ponderosa pine is one of the most widely distributed and one of the most important forest trees of North America. Information concerning its management and expected yields is, therefore, of broad interest. It has been found that the net annual increment for blackjack is around three per cent of the original volume and that for yellow pine the net increment is usually less than one per cent. In average stands of the Southwest an average volume of 4,000 board feet per acre may be expected to yield a net annual minimum of 80 to 100 board feet over a period of twenty years. Increasing the reserve will raise the net increment only to the extent that the additional growing stock is made up of thrifty trees below 30 inches d.b.h. and so situated as to utilize growing space normally left vacant by heavier cutting.

PROSPECTS of lighter cutting and shorter cutting cycles, to be made possible by the introduction of truck ogging, give rise to thoughts about modiying marking rules and speculation as to uture yields. The idea is not at all revoutionary, but rather expresses a longherished silvicultural ideal. Past cutings in the Southwest have, with some xceptions at both extremes, left a growng stock of from 2,000 to 3,500 board eet per acre. This practice assumes a cuting cycle of from 60 to 75 years. If a utting cycle of 30 years becomes pracical, residual volumes can increase to rom 4,000 to 6,000 board feet and perhaps more in some stands.

The volume of the reserved stand or the per cent to be removed or left cannot be lecided in an arbitrary manner. It must e determined by the character of the riginal stand and the choice of interval etween cuts. Obviously, trees are not oing to be left whose physical condition loes not warrant the expectation of surival until the next cut. Frequent salvage perations may become practical on the nore accessible areas, but generally they annot be taken for granted in the near uture.

Composition of Cut-Over Stands

To visualize a stand of 6,000 or as high as 10,000 board feet after cutting is not a tax on the imagination. We have them already on limited areas. The average cut-over area in the Southwest is a veritable mosaic of volume groups and age groups. This is true only in less degree in other regions. Volumes on individual acres vary from 1,000 to as much as 10,000 board feet. Lightening the cut will affect only the mature age classes or "yellow pine" because it has been standard practice in the past to remove only defective or declining trees from the younger classes. In fact, it is conceivable that immature or "blackjack" groups may be cut slightly heavier in the future by going farther in removal of dominating trees of poor form. Intermediate age classes, or those approaching maturity, have likewise been lightly cut in the past and will continue to be thus treated. The broad age classes, "blackjack", "intermediate", and "yellow pine", correspond to Keen's (1) Classes II, III, and IV. The approximate ages are: blackjack below 175 years, intermediate 175 to 225 years, and yellow pine over 225 years.

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[1]Maintained at Tucson, Arizona, by the Forest Service, U. S. Department of Agriculture, in ooperation with the University of Arizona, and covering Arizona, New Mexico, and the western ne-third of Texas.

Increment of Mature and Immature Stands

Large sample plots on which all trees have been periodically measured for as long as 25 years, have made it possible to compare the performance of the three broad age classes on an area-and-volume basis. The 25-year records are from a 480-acre plot (S3) logged in 1909 and measured the same year. Another cut-over plot (S7) of 160 acres and an adjoining virgin stand (S6) of 160 acres have individual tree records of 10 years. The more heavily stocked portions of the cut-over plots furnish the best available approach to problems concerning a lighter type of cutting.

Tables 1 and 2 have been compiled from growth records on small plots representing different age classes within large sample plots, S3, S6, and S7, of the Fort Valley Experimental Forest. The desirability of breaking up the larger plots is suggested first by the fact that the age classes naturally occur in groups and secondly by the fact that after cutting, and even before cutting, large portions of the area are virtually unoccupied by trees beyond the sapling stage (Fig. 1). In selecting small plots on the cut-over areas the aim was not to obtain complete stocking, but rather a degree of stocking that might be maintained in a program of cutting and restocking through a rotation. The boundary lines are commonly drawn 30 to 40 feet beyond the outside trees in order to accommodate most of the root spread and also to allow space for natural restocking. Open spaces up to 75 feet in diameter occur within the plots. Thrifty seedlings, started since cutting, occur on substantial portions of the plots as shown in Figure 1. Since no exact method of locating the boundaries of such plots is available, they were drawn according to the author's best judgment, or, as in S3 A and S3 B, rectangular blocks were formed out of the tenth-acre squares into which the plots were divided in the original mapping.

With respect to increment, the outstanding relationship is the superiority of blackjack groups over yellow pine groups. To obtain increments on yellow pine plots approaching those of blackjack plots requires a much larger volume of yellow pine growing stock. This comparison refers to gross increment. Net increment would show a still larger disparity. The yellow pine plots here used were purposely selected to avoid mortality because on small plots the death of a single large tree offsets growth for an entire decade. It is difficult to find yellow pine plots as large as 1 acre which have not lost at least one large tree in 25 years. The same thing may happen in a blackjack group, though less commonly and the effect is less pronounced because the trees are smaller and when one is killed there are usually several smaller ones ready to take its place. The subject of mortality will be more fully discussed later.

Blackjack groups in Tables 1 and 2 show no very consistent relation between increment and volume of growing stock. This may be due to several factors such as the size of individual trees, overstocking in some of the high-volume plots, and finally the fact that even the plots of lowest volume are not seriously understocked. Also, it is known that some of the most heavily stocked plots, notably S3 B-3 and B-4, are handicapped by mistletoe. Such plots as S3 B-1, which has produced a net annual increment of 23[illegible] board feet per acre, represent nearly an ideal condition. The larger plot S3 B-[illegible] with a net increment of 163 board feet presents a sample of what should be attainable on extensive areas.

The yellow pine plots show a rise of gross increment with volume per acre until the heavily stocked plots in the virgin stand are reached, indicating that somewhere above 12,000 board feet per

TABLE 1

25-YEAR RECORD OF INCREMENT AND MORTALITY ON SUBDIVISIONS OF SAMPLE PLOTS S3 A AND S3 B, 1909 TO 1934. AREA LOGGED IN 1909. ALL VOLUMES IN BOARD MEASURE

Plot	Area	Trees per acre 12 inches +		Net volume 12 inches +		Annual increment			Annual mortality	Note
		1909	1934	1909	1934	Gross	Net	Net		
	Acres	*No.*	*No.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Per cent*	*Ft.*	
				Blackjack plots						
S3 A										
2	1.2	29.0	38.0	4702	8454	156	150	3.2	6	Heavy mistletoe
3	0.6	27.0	33.0	4347	8787	178	178	4.1	0	
4	0.6	32.0	43.0	4900	10698	232	232	4.7	0	
5	1.2	22.0	28.0	3298	6743	153	138	4.2	15	
6	2.0	19.0	25.0	4404	8030	154	145	3.3	9	
S3 B										
1	1.2	37.0	47.0	7482	13245	236	231	3.1	5	
3	2.0	31.0	32.0	6337	8936	144	104	1.6	40	Heavy mistletoe
4	1.5	26.0	23.0	4753	7322	135	103	2.2	32	Heavy mistletoe
5	4.0	25.0	30.0	5907	9986	165	163	2.8	2	
				Yellow pine plots						
S3 A										
7	1.8	6.0	6.0	3623	5218	64	64	1.8	0	
8	1.0	4.0	4.0	2856	3858	40	40	1.4	0	
				Average for larger plots[1]						
S3 A	12.0	13.2	16.8	3412	5462	98	82	2.4	16	Y.P. and B.J.
S3 B	12.0	21.5	22.9	4362	7012	119	106	2.4	13	All B.J.
S3	456.0	11.7	13.7	3520	5677	105	86	2.4	19	Y.P. and B.J.

[1]Sample Plot S3 contains 480 acres. Within it are two "intensive" plots, A and B, of 12 acres ach, on which the records have been more detailed than on the remaining 456 acres. The small lots above are within S3 A and S3 B.

TABLE 2

10-YEAR RECORD OF INCREMENT AND MORTALITY ON SMALL PLOTS WITHIN SAMPLE PLOTS S3, S6, AND S7, 1924 TO 1935. ALL VOLUMES IN BOARD MEASURE

Plot	Year logged	Area	Trees per acre 1924: Total over 12 inches	Trees per acre 1924: 20 to 30 inches	Trees per acre 1924: Over 30 inches	Ht. of domi-nants	Volume per acre 1924	Volume per acre 1934	Annual increment per acre: Gross	Annual increment per acre: Mortal-ity	Annual increment per acre: Net	Annual increment per acre: Net
		Acres	*No.*	*No.*	*No.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Per cent*
				Cut-over yellow pine								
3 A-7	1909	1.00	4.0	3.0	1.0	100	3542	3858	32	0	32	0.9
3 D	1909	1.50	9.0	7.3	1.3	102	7613	8767	115	0	115	1.5
3 F	1909	0.70	14.0	7.1	4.3	103	12507	14251	174	0	174	1.4
				Cut-over blackjack and intermediates								
3 B-6	1909	2.60	36.0	20.4	0.4		11262	12744	165	17	148	1.3
7 A[1]	1924	1.11	34.0	8.2	0.0		6406	8487	208	38	170	2.6
				Virginia stand yellow pine								
5 A[1]		0.43	26.0	20.9	4.7	110	29430	31072	164	0	164	0.6
5 B[1]		0.70	24.0	17.1	2.9	100	18600	19800	118	0	118	0.6

[1]Records extend from 1925 to 1935.

acre, volume ceases to be an important factor. Investigations by Lexen (3) have shown that increment rises with volume but at a constantly decreasing rate. Although correlation of increment with volume of growing stock is not a major object of this paper it is in order to point out that a large growing stock of fairly thrifty yellow pine (Figure 2) is capable of yielding a gross annual increment up to 174 board feet per acre.

Diameter Growth

Diameter growth varies greatly in blackjack groups. Small trees which were benefited by the removal of larger neighbors in the logging operation have increased in diameter as much as 8 inches in 25 years. Some of the thrifty dominants 24 inches d.b.h. at the time of cutting have grown to 30 inches. The majority of codominants and intermediates are marking time, but promise to persist indefinitely unless infected with mistletoe. Judging by past performance, such trees will respond with phenomenal growth whenever released, even after 50 or 100 years, unless they should become distinctly suppressed in the meantime. Present indications are that practically all the blackjacks which have good boles are worth saving as potential crop trees.

Yellow pines in the various cut-over groups of Table 2 have grown in diameter with remarkable uniformity, averaging close to 1.60 inches in the last decade of a 25-year period after cutting. In the virgin stands the increment has been distinctly less, averaging 0.70 and 0.71 inch per tree for each of the two groups listed.

Krauch (2) has compared the diameter growth of blackjack and yellow pine by diameter classes on 400 acres of heavy, light, and intermediate cutting. He found that during a period of 20 years after cutting blackjacks consistently grew more in diameter than did yellow pines of the same diameter class.

Large Trees Are Inefficient Producers

Both yellow pine and blackjack of the higher diameter classes are capable of rapid diameter growth if they have adequate growing space. Krauch finds but little decline with size up to 30 inches d.b.h. But considering both wood and land capital, large trees give a lower rate of increment than do smaller trees, Lexen (3) has found that, for a given volume of growing stock, increment per acre decreases as the diameter of the average tree increases. Several reasons may be given in explanation of this relationship. An obvious one is that large trees commonly have relatively less active leaf surface than do smaller trees. Probably a similar relation exists with respect to roots. Suppose, for example, that a single tree of 2,000 board feet occupies a space of one-tenth acre. Its roots are capable of extending beyond the allotted area but it is unlikely that they can occupy the whole area so completely as the roots of four well spaced trees of 500 board feet each. A dense stand of small trees shades out other vegetation while an open stand of large trees must share the soil moisture with an understory of young trees or with a heavy crop of grass.

Mortality tends to increase this handicap, as may be seen from Figure 3. The per cent of loss in each group of diameter classes represents the relation between the volume of the trees that died during 20 years and the total volume of all the trees in that diameter group at the beginning of the period. The per cent of mortality rises rapidly above the 24-inch diameter class. As shown by the summary table, the classes above 30 inches lost more than twice as heavily as those between 20 and 30 inches. Another plot of 480 acres has a lower total loss, but a similar relation between diameter classes. A typical story of growth and mortality is dramatically told by a single tall, clean

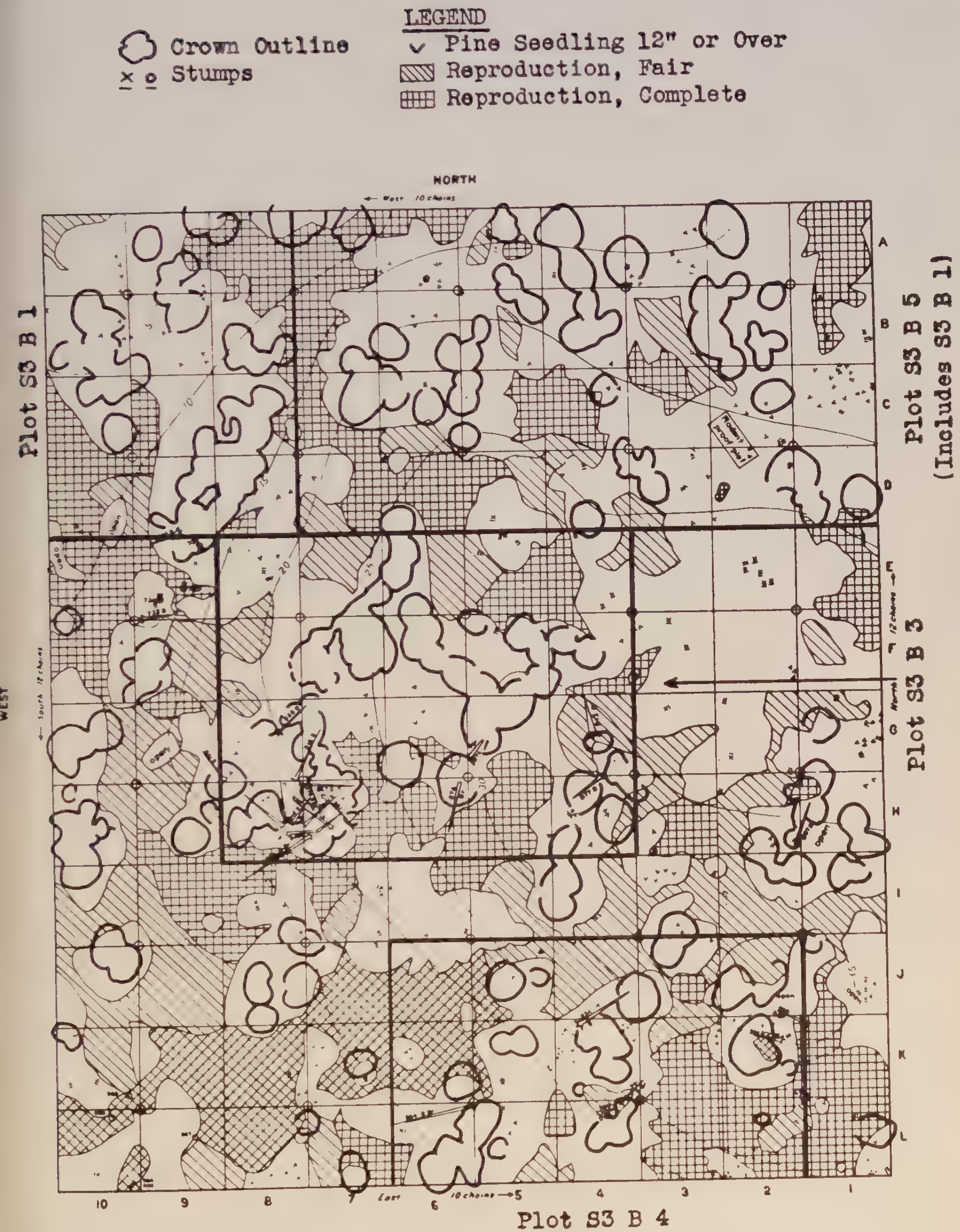

Fig. 1.—Sample plot S3 B, Kaibab National Forest.

boled veteran on Plot S3 A-8 (Table 1). Between 1909 and 1934 it grew in diameter from 31.4 to 36.7 inches and in volume from 1,387 to 1,987 board feet. During this period of 25 years it was struck by lightning three times and is finally dying. Unless this tree is salvaged, its loss will equal almost twice the gross increment on this acre in 25 years.

There are many angles to the mortality question. One theory is that by increasing the number of large trees the *per cent* of loss declines because lightning, which is one of the two major enemies, strikes no more trees in a population of 20 per acre than in a population of 5. In some instances the high quality of large trees may offset lower volume increment and higher loss. On the other hand, if a large tree of poor form is dominating one or more smaller ones of good form, the argument is all in favor of cutting the large tree.

The Probable Life of Different Age Classes

In blackjack stands the stage is set for sustained high yields over a long period. Although nearly even-aged in point of years, the range in diameter is large enough to provide the equivalent of many age classes. Ponderosa pine may persist indefinitely in a subordinate position and, when released, respond with vigorous growth. The average blackjack group contains enough trees of different diam-

Fig. 2.—Location of large trees after cutting sample plot S3 F.

eters (Table 3) to provide four or five cuts at intervals of 30 years. Each time a large tree is removed several smaller ones will respond by increasing their diameter 4 to 8 inches in the ensuing 30 years. Before the last cut, the depleted ranks of the original stand will have been filled by a new generation approaching merchantable size. Whether these young age classes will be adequate to prevent a slump in production depends on the area occupied by them at the time of the first cutting and upon subsequent reproduction.

Mature groups are inevitably on the down grade. On the average, there are not enough thrifty trees to provide an effective growing stock. Even in the few thrifty groups where it is possible to leave as much as 10,000 board feet per acre in the initial cut, the third cut 60 years hence will leave only a few trees. This statement, though admittedly only a prediction, may be checked by considering diameter growth and mortality. At an average growth rate of only 1.3 inches per decade, practically all normal trees over 21 inches d.b.h. at the time of the first cut will advance to 30 inches in 60 years. The best available mortality figures indicate a loss of 28 per cent in 20 years for trees over 30 inches d.b.h. If future records approach this figure it is not likely that cutting will leave many trees over 30 inches d.b.h. Taking the yellow pine class as a whole, lightning and wind exact such a huge toll that only by continuous salvage operations can a substantial net increment be realized. If the first cut is very light, large areas under and immediately surrounding yellow pine groups will permit no reproduction until after the second cut. If restocking is delayed until the second cutting cycle, the last of the original yellow pine stand will have been removed long before the new generation can figure appreciably in board-foot volume.

In stands where the intermediate age class predominates over the mature and overmature, the situation is more hopeful, though even here the trail has begun winding down hill. This class is only about 50 years older than the advanced blackjack class, but physiologically the difference is much greater. The trees in intermediate groups are larger and in most instances they have already eliminated the subordinate stems that, in a blackjack group, can be saved by timely liberation. The useful life of intermediate groups is estimated at from two to three 30-year cutting cycles.

The Probable Character of Later Cuts

The character of the second cut will depend upon economic as well as silvicultural objectives. Silviculturally, quick replacement of old age classes with young ones is desirable, but for economic reasons it may be desirable to hold the older classes as long as possible. The latter policy is reflected in the economic selection cutting now being tried out in the Northwest. Recreation is another influence

Table 3

NUMBER OF TREES PER ACRE BY DIAMETER CLASSES IN 1909 AND 1934 ON TWO BLACKJACK PLOTS

Plot	Area of plot	Year	Number of trees per acre in d.b.h. class: 5 to 11 inches	12 to 18 inches	19 to 24 inches	25 to 30 inches	Over 30 inches	Total over 11 inches	Total over 5 inches
	Acres		*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
3 B-5	4	1909	13.25	13.25	10.25	1.75	0.00	25.25	38.50
		1934	6.75	12.00	13.00	4.75	0.25	30.00	36.75
3 A-6	2	1909	17.50	11.50	6.00	1.00	1.00	19.50	37.00
		1934	9.50	13.50	7.50	2.50	2.00	25.00	34.50

on the side of light cutting. In the Southwest, however, mortality places a rigid limitation on reserving large trees unless the set-up insures continuous salvage. Regardless of economic preferences, it will probably be necessary in most stands to make heavy inroads upon the original mature and intermediate classes in the third, if not in the second cut. The second cut should at least open up mature groups enough to encourage reproduction wherever this has not been done. Observations indicate that for trees over 24 inches d.b.h. a spacing of about 60 feet will permit development of seedlings (Figure 4). Each cut should make a point of removing trees of poor form that are dominating younger age classes. As a long-range policy, economic as well as silvicultural objectives must point toward converting predominantly mature or overmature stands into stands that are predominantly immature.

In blackjack groups the second cut may take either of three courses. One would remove only declining trees, as in the first cut; another would, in addition, take out most of the trees above 26 inches d.b.h., and also a few smaller ones by way of improvement and release cutting; the third might open up the stand more drastically. Under the first method the result would not be essentially different from the natural course in which blackjack groups gradually change to yellow pine, in the meantime losing a substantial portion of the growing stock through the operation of wind, lightning, and suppression. The second method would attempt to save all desirable stems by forestalling mortality

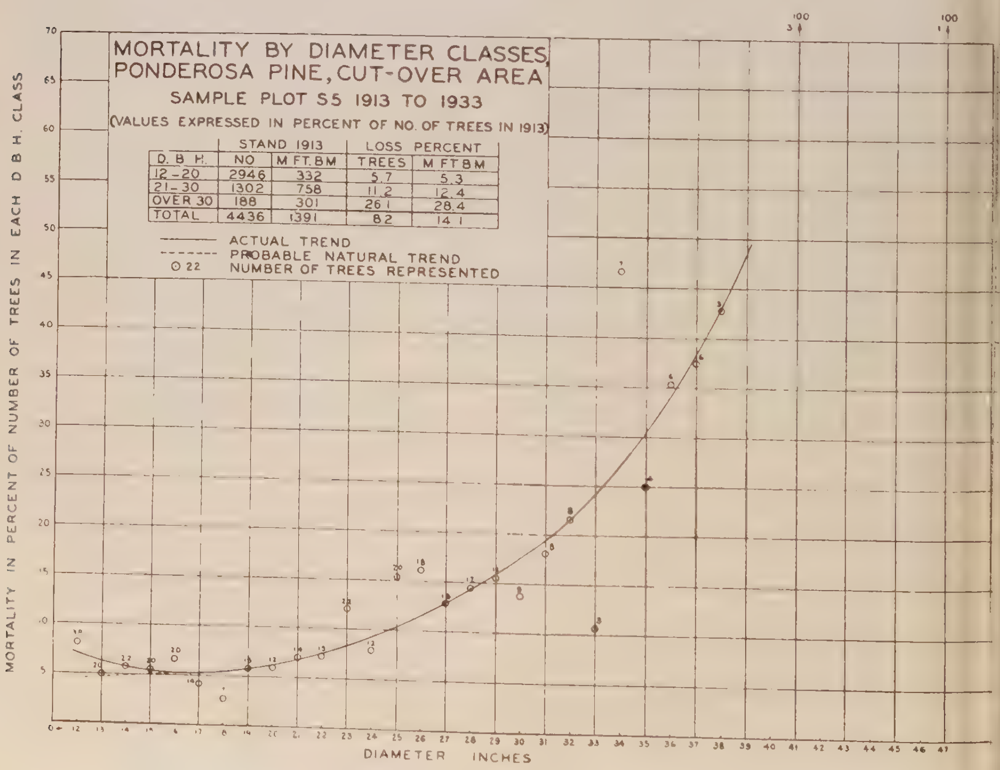

Fig. 3.—Mortality by diameter classes, ponderosa pine, cut-over area.

in large diameters, and by periodic release and improvement cutting. The third method would stimulate increment temporarily at the expense of prematurely exhausting the growing stock. In the light of this investigation, the second course appears to be the most desirable one. The rate of removal of the blackjack class may be influenced in large measure by the presence or absence of younger age classes in the stand as a whole. Pole and sapling classes figure prominently in some stands while in others they are practically absent.

Probable Yields

It is customary to think of the proposed change from heavy to light cutting as conducive to higher increment. Since blackjack and intermediate classes are already being lightly cut, the change would affect only mature classes. An important factor in present low increment after cutting is the presence of considerable areas which are virtually unstocked with trees that count in board-foot volume. Lighter cutting would scarcely improve this situation because where the first cutting leaves a deficient growing stock it is usually in spots that originally contained few trees suitable for leaving.

Any increase in yield that may be expected from lightening the initial cut will be determined by the number, size, and vigor of trees in the added growing stock. In overmature stands where a growing stock of 2,000 board feet under present cutting practice yields a net annual increment of about 60 board feet per acre, an increase of the growing stock to 4,000 board feet would, according to 20-year sample-plot records (3), raise the increment to about 90 board feet. If a further increase of the reserved stand to 6,000 board feet would, according to 20-year mature timber of large diameter and in groups that are already fairly well

Fig. 4.—Natural reproduction of ponderosa pine 27 years after logging. Practically all the seedlings started 10 years after cutting. The isolated trees are "yellow pines" 24 to 32 inches d.b.h.

stocked, the net increment will benefit but little. Mature stands of diameters mainly over 24 inches rarely have a gross annual increment above 1.5 per cent while mortality is likely to be as high as 1.0 per cent. But if the original stand is such that leaving an additional 2,000 feet will fill in open spots with trees of fairly good crowns, the annual increment may be raised to 120 board feet or even more. Exceptional stands on the Coconino and Sitgreaves contain enough thrifty timber for a reserve of perhaps 8,000 board feet per acre over large areas, and the current net annual increment on such areas may be as high as 150 board feet per acre. This figure should be generally attainable in the Southwest after management has been in progress long enough to attain reasonably full stocking and a proper gradation of age classes.

Many of the questions which are now being asked cannot be conclusively answered until more specific experimental data are available. It is planned to establish a series of cutting plots in the heavy and relatively young stands of the Long Valley Experimental Forest on the Coconino in 1938. In the Fort Valley Experimental Forest, a second cut is contemplated in 1939 on the 480-acre Plot S3 (Table 1) logged in 1909. Although a whole cutting cycle is required to give the final answers 10 or 15 years will serve to indicate trends. The third cutting cycle, 30 years hence, will see large groups made up entirely of trees which started after the first cutting. Only then will the whole story of continuous yield begin to unfold.

Summary

1. Past cuttings of ponderosa pine in the National Forests of the Southwest have left volumes of from 2,000 to 3,500 board feet per acre. Net increment over a 20-year period has been from 60 to 90 board feet.

2. Due to the heterogeneous character of virgin stands, the volume left by the first cutting varies on individual acres from 1,000 to as much as 10,000 board feet.

3. There are three broad age classes among trees of merchantable size: blackjack (below 175 years), intermediate (175 to 225 years), and yellow pine (over 225 years).

4. Blackjack plots with a growing stock of 4,000 to 6,000 board feet per acre commonly return a current net annual increment of 150 board feet and as high as 232 board feet per acre. Yellow pine plots approach these figures only with a larger reserved volume and then only where mortality happens to be low.

5. Net annual increment for blackjack is around 3 per cent of the original volume; for yellow pine, the gross increment is seldom over 1.5 per cent and mortality will usually reduce the net increment to less than 1 per cent.

6. The rate of mortality based on volume rises rapidly beyond the 24-inch diameter class. On a 400-acre plot, the portion of the stand that measured above 30 inches d.b.h. at the time of cutting lost 28 per cent of its original volume in 20 years.

7. Leaving a larger volume in the first cut will increase the net increment up to a certain point which varies with the character of stand. Beyond this point, mortality tends to offset increment.

8. In average stands of the Southwest a reserve volume of 4,000 board feet per acre may be expected to yield a net annual increment of 80 to 100 board feet over a period of 20 years. How long this rate will continue is not known. Increasing the reserve will raise the net increment only to the extent that the additional growing stock is made up of thrifty trees below about 30 inches d.b.h. and so situated as to utilize growing space normally left vacant by heavier cutting. In exceptional stands it may be possible to

leave an effective growing stock of as much as 8,000 or even 10,000 board feet per acre.

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Fighting Forest Fires in Canada

CONSTANT experiments and research on the part of forest authorities in Canada during the last twenty years have brought about great advances in the development of equipment and technique for detecting and controlling forest fires. The use of the airplane for fire patrol and transportation, the development of light portable fire pumps and linen fire hose, light-weight radio apparatus for communication, hand spray pumps, and miscellaneous equipment are a few of the results. Investigations are still under way on the use of chemicals in fire suppression, and on further improvements in radio, fire pumps and equipment. Statistics compiled by the Department of Mines and Resources, Ottawa, show a decrease of about 60 per cent in the area of merchantable timber burned per fire during the period 1918-1937. On the other hand, despite the efforts of protective agencies, the total area burned over in 1937 exceeded 4,271,000 acres, representing a direct loss in timber and property values of more than $3,550,000 and a cost in actual fire fighting of $790,300. Much of this loss could have been avoided, as 86 per cent of these fires were the result of human carelessness.

ROOT DEVELOPMENT AS A FACTOR IN THE SUCCESS OR FAILURE OF WINDBREAK TREES IN THE SOUTHERN HIGH PLAINS

By MYRON T. BUNGER[1] AND HUGH J. THOMSON[2]

The early settlers who came to the southern and central high plains from the more humid regions where shelterbelts could be established by merely planting the trees and waiting for them to grow followed these same practices in this treeless region, but without success. They soon learned that trees could neither be established nor maintained as easily in these treeless plains as at home. As a result, the idea that trees could not be grown in this region became widely accepted. For this reason only a few trees have been planted in recent years. In order to obtain better survival and growth, a few farmers have tried various cultural methods, such as clean cultivation. Some farmers even have used dynamite to break the calcareous layers underlying the surface. In spite of these practices, which are doubtless of some value, most of the trees do not withstand the severe drouth conditions existing in this region. Fortunately, some of the species that were planted in these original shelterbelts have survived even the severe drouth period of 1930-1937. From these survivors much can be learned.

THE object of this study was to determine some of the factors that may have contributed to the success or failure of the species planted in the southern and central high plains. Because the reasons for survival or death were not obvious, a study was made of the rooting habits and of the relations of the root growth of various species in different soils and spacings to survival. It was thought worthwhile to study not only the root systems but also the rate of root growth of the survivors to determine whether or not any relationship exists between these factors and survival.

Review of Literature

Considerable information is available on the root systems of fruit trees (5, 6, 7, 9, 10) in the more humid regions, but little is available for trees in semiarid regions. Even for the same region the information that has been published is often very conflicting. Clark (1) found that the roots of apple and apricot trees were definitely limited to the zone of weathering in compact clay loam, underlaid at a depth of 14 to 24 inches with silty clay mottled with white calcareous material that changed to soft unweathered caliche at approximately 48 inches. Approximately 97 per cent of the roots was in the upper 24 inches of soil and the remaining 3 per cent was in the first 3 inches of the third foot of soil. Yocum (14) found that 17-year-old Jonathan and Duchess apple trees roots penetrated a loess soil to the extreme depths of 33 and 30 feet, respectively. He also found that the depth of root penetration of 2-year-old Delicious apple trees varied with the type of soil, with the presence or absence of an intercrop, and with the kind of mulch used—straw, paper or sod. In a loess soil under clean cultivation, the roots penetrated to 12 feet, and spread laterally 18 feet. An intercrop of corn planted 3.5 feet from the trees increased root penetration, but decreased the lateral spread. The vertical roots of these trees penetrated to 14.75 feet, but the laterals spread only the 3.5 feet to the row of corn. Under sod and paper mulch, the root systems were considerably dwarfed in both directions.

Yeager (13) studied the roots of 31 species of trees and shrubs in a poorly drained, heavy-clay soil, underlaid by a light-colored calcareous clayey subsoil, and also in a light, well-drained Barnes loam. The roots of northern cottonwood and Hebernal apple penetrated to 10 feet and 10.25 feet, respectively, while the

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other species penetrated the soil from 2.66 to 7 feet. He found that the roots spread and penetrated about the same distance in the lighter, more sandy Barnes loam. Yeager (13) therefore concluded that shallow wide-spread root systems permit trees to utilize more fully deficient natural rainfall in semi-arid regions because little of the water reaches the subsoil. He also concluded that the less drouth-resistant species form larger vertical roots than most drouth-resistant species.

Hayes and Stoeckeler (4) studied the root systems of ponderosa pine, hackberry, honey locust, bur oak, mulberry, and Osage orange, and found that their roots penetrated to a depth of 10 to 20 feet. Green ash, American elm, red cedar, Russian olive, caragana, boxelder, and black locust penetrated the soil 5 to 10 feet; whereas jack pine, Scotch pine, Norway spruce, white willow, cottonwood, and catalpa penetrated the soil to only 1 to 5 feet. They also observed that the deep- and intermediate-rooted species survived the long drouth much better than the shallow-rooted species. Furthermore, they observed that even trees of the same species showed great variations in rooting habits. The roots of the same species were affected by the amount of space given to the roots when the trees were planted, the spacing of the trees, the topography, and the texture of the soil, which in turn influences the moisture supply.

Methods of Procedure

Most of the trees studied were well-established trees in the windbreaks surrounding the orchard at the Panhandle Agricultural Experiment Station at Goodwell, Oklahoma. The remaining trees were located within a radius of 100 miles of Goodwell. The number and species excavated are as follows: 5 apricot, 3 Osage orange, 9 Asiatic elm, 2 eastern red cedar, 7 black locust, 5 Russian mulberry, 2 thornless honey locust, 2 black walnut and 8 ash.

The lateral growth of the roots was determined by removing the soil in 1-foot layers within a radius of 10 feet of each tree. Roots longer than 10 feet were uncovered and traced to the end. After the roots 1/8 inch and larger in diameter were drawn to scale, another foot of soil was removed and the foregoing procedure repeated until all the lateral roots were excavated. No attempt, however, was made to follow the fibrous roots. The vertical or deep-penetrating roots were followed by digging a pit approximately 4 by 6 feet with the outer wall located 4 feet from the tree and the inner wall making a longitudinal section through the soil directly beneath the center of the tree. Screw drivers were used to remove the soil in contact with the roots. The roots were measured for diameter and length, and also photographed and drawn to scale. The roots of species with very deep root systems were not followed to their maximum depth because of the work involved.

The percentage of moisture in samples from each soil horizon of several excavations was determined by the usual procedure. Additional soil moisture samples to supplement the foregoing determinations were obtained under the feeding areas of deep- and shallow-rooted species and in adjacent fields. The samples were taken at 3-foot intervals from 2 to 29 feet from the surface, or until the auger hit an impervious layer.

These soil samples were air dried, pulverized with a roller, an mechanically analyzed by Bouyoucos' hydrometer method, using sodium-hydroxide and sodium oxalate as a dispersing agent.

Types of Soil

The type of soil in which these trees grew is classified as Richfield silt loam (3). The soil horizons in the excavations at the Experiment Station were rather uniform, but varied slightly in depth and thickness. The surface soil was a very dark brown or chocolate-colored, fine,

granulated clay loam that gradually changed to a lighter brown more compact clay. A white chalky zone of calcification occurred 5 to 11 feet below the surface. In this zone the concentration of lime varied considerably, but in one layer that varied from 1 to 2 feet in thickness the lime was highly concentrated and rock-like, while in the soil 2 to 3 feet above and 5 to 7 feet beneath this layer, caliche pebbles occurred only occasionally. Below this calcified zone the horizons to a depth of 25 to 30 feet from the surface varied from a very friable, reddish brown and red sandy clay loam to a sandy loam, both mottled with lime accumulations at lower depths.

Results

Depth of Penetration and Lateral Spread of Roots.—This study indicates that some tree species have a combination of both wide-spreading lateral and deep-penetrating vertical roots, and other species have only wide-spreading lateral with few or no vertical roots. In soil that is unoccupied by other vegetation their horizontal roots are relatively close to the surface and extend out from the tree for considerable distances. The vertical or deep-penetrating roots are usually located more or less directly under the center of the tree.

Table 1

DEPTH OF PENETRATION AND SPREAD OF ROOTS OF ESTABLISHED SHELTERBELT TREES

Name	Depth of penetration	Length longest lateral root
Deep-rooted trees	*Feet*	*Feet*
Asiatic elm, *Ulmus pumila*	27	43
Osage orange, *Toxylon pomiferum*	27	14
Eastern red cedar, *Juniperus virginiana*	25	20
Black locust, *Robinia pseudoacacia*	26	21
Medium-rooted trees		
Russian mulberry, *Morus alba*	13	42
Thornless honey locust, *Gleditsia triacanthos inermis*	11	28
Shallow-rooted trees		
Seedling apricot, *Prunus armeniaca*	8	32
Ash, *Fraxinus* species	6	43
Western black walnut, *Juglans rupestris*	6	52

The depth of penetration and the lateral spread of the root systems studied varied greatly with the species, vigor, competition, spacing, type of soil, soil moisture, and with other factors. These root systems may be divided into 3 groups according to depth of penetration. Table 1 shows that on the average the shallow-rooted species penetrated the soil less than 10 feet, the medium-rooted species from 10 to 15 feet, and the deep-rooted 15 feet or more.

The area covered by the lateral roots of several species increased with an increase in the size of the crown, as shown in Table 2. Most of the lateral roots of Asiatic elm, Osage orange, red cedar, and the most vigorous trees of Russian mulberry were located in the upper 1-foot of soil. On the other hand, most of the lateral roots of seedling apricot and the less vigorous specimens of the Russian mulberry were located in the second foot of soil, as shown in Table 3. The lateral roots of Russian mulberry penetrated the soil deeper than those of other species though none of the lateral roots of any of the species were below five feet.

The dominant trees of Asiatic elm (*Ulmus pumila*), that had grown in single rows or on the outside of several rows, had extensive lateral root systems that spread over large areas, as shown in Figures [5] and 6. Most of these roots were between .5 and 1.0 inch in diameter, and the largest did not exceed 2.5 inches. A large number of fine fibrous roots grew from these larger roots. The three longest lateral roots of this species grew into

cultivated field 33, 41 and 43 feet. Usually from 2 to 6 vertical roots of ıch elm grew straight down through the ılcareous layer to a depth of more than 5.5 feet, the maximum depth of the pits. he most striking facts about these ver-cal roots were their small diameter ıd the variation of this diameter. In e lower more favorable soil horizons e diameter was larger than in the less vorable upper layers. For example, e diameter of one root varied as fol-ws: 1 inch at 1 foot, 14/16 of an inch 4 feet, 9/16 of an inch at 7 feet, 2/16 f an inch at 11 feet, 3/16 of an inch 14 feet, 4/16 of an inch at 20 feet, ıd 3/16 of an inch at 26 feet. Because e diameter of the vertical roots de-eases rapidly in diameter from the root own to about 7 feet and then either mains about the same or sometimes en increases in size below the calcareous ne, one might inadvertently stop ex-vating too soon and then draw the er-neous conclusion that the species was allow-rooted.

The lateral roots of the elms spaced) feet apart in the center row of a three w planting extended over a much naller area than the roots of trees grown in a single row. The row of elms was located 12 feet from a row of mulberry and 10 feet from a cedar row. The longest laterals were only 15 feet in length, and the whole lateral root system covered an area of only 50 square feet. Many of the lateral roots grew parallel to the surface for a distance of 2 to 4 feet, and then turned down and grew through the calcareous layer.

The Osage orange (*Toxylon pomiferum*) had a very deep root system consisting of many branching vertical roots that ran obliquely from the root crown and occupied a large area. The vertical roots were followed to a depth of 27 feet through a calcareous layer. In an area of 9 square feet at the bottom of the 27-foot pit there were still 6 separate roots that grew below the bottom. These vertical roots were smaller in diameter at the root crown than the Asiatic elm, but they did not decrease in size so rapidly.

The lateral roots of red cedar (*Juniperus virginiana*) which were excavated were not very extensive since they were in competition with those of Asiatic elm and Russian mulberry on the north and weeds in an uncultivated fence row less

TABLE 2

SPREAD OF LATERAL ROOTS AND SIZE OF CROWN OF SHELTERBELT TREES

Name	Tree No.	Size of Crown Height	Size of Crown Width	Spread of lateral roots
		Feet	*Feet*	*Sq. feet*
siatic elm	1	14	8	199
	2	12	7	229
	3	13	12	235
	4	14	8	240
	5	16	12	394
	6	20	19	546
ussian mulberry	1	10	8	190
	2	11	8	247
	3	12	10	309
	4	11	11	330
eedling apricot	1	8	8	140
	2	8	8	196
	3	11	10	346
	4	12	10	363
sh	1	10	9	266
	2	13	10	308
	3	14	15	468
	4	19	15	566

than 15 feet away on the south. The longest lateral root was slightly more than 20 feet, but the majority grew parallel to the surface for about 3½ feet and then grew obliquely downward forming an umbrella-shaped outline (Fig. 2). Many of these large roots branched irregularly into smaller roots and these smaller roots in turn branched into an enormous number of fibrous roots.

The vertical roots of the red cedar directly beneath the root crown were considerably more vigorous and numerous than the roots of other species. Under one tree in an area of about 36 square feet, eleven roots extended through the calcareous layer and continued downward to a depth of 15 feet, the depth excavated. These roots average about ⅛ of an inch in diameter. Fragments of roo 1/16 to 1/32 of an inch in diameter we found at a depth of 24.5 feet in so auger borings taken 5 feet from the tre indicating that the vertical roots pen trated much deeper.

In an uncultivated site, the longest la eral roots of black locust (*Robinia pseu doacacia*) extended only 21 feet and th vertical roots generally branched oblique from the root crown. From 4 to 7 o these deep-penetrating roots extended ve tically through the calcareous layer. Thre roots grew horizontally for 7, 11 and 2 feet, respectively, before turning dow ward. All the deep roots were unco ered to a depth of 26 feet, but man went deeper than this.

These data indicate that the dee

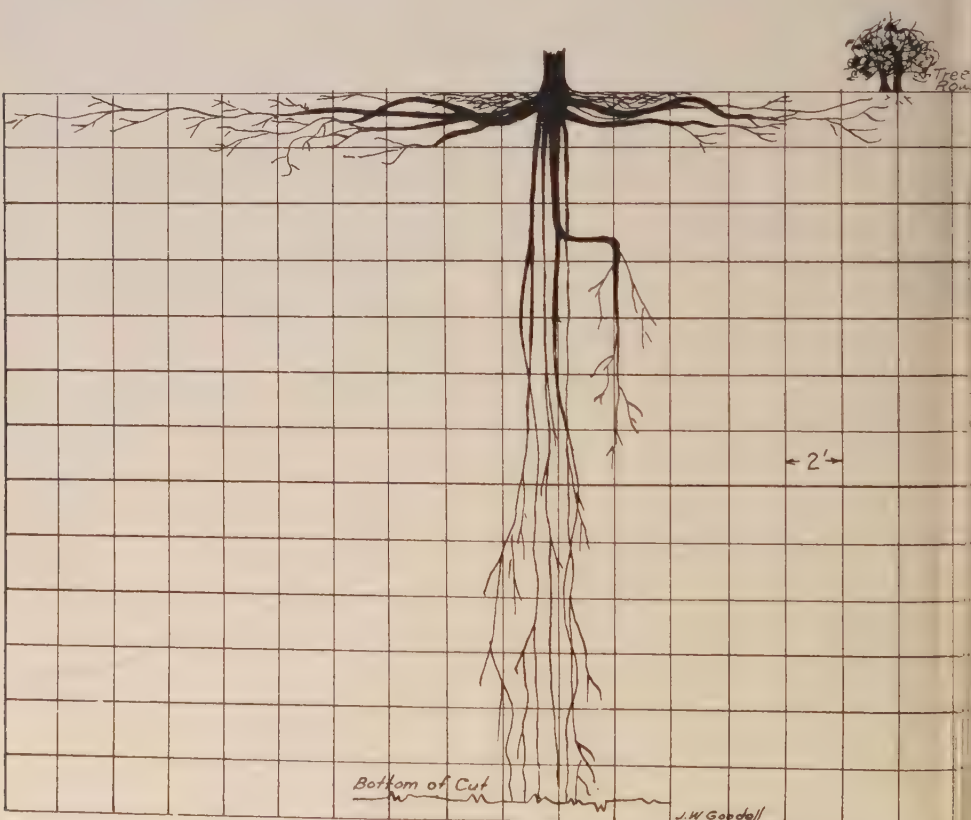

Fig. 1.—Root system, 9-year-old Chinese elm growing in Richfield silt loam with zone of heav calcification at depth of 5½ feet.

Fig. 2.—Red cedar root system, during the process of excavation.

rooted species were able to penetrate the calcareous layer and to develop lateral roots to some extent, regardless of competition. When the trees were spaced a considerable distance apart, they grew very extensive lateral and well-developed vertical deep-penetrating roots. Furthermore, when competition was keen many of these lateral roots grew downward. Because of this trait, these species survived very unfavorable conditions.

The roots of Russian mulberry (*Morus alba tatarica*) were brilliant yellow with occasional vivid purple spots under the epidermis. They were large in diameter close to the root crown but decreased rapidly in size and branched within a few feet from the tree into a myriad of fibrous roots. One root, which was 2.75 inches in diameter at the crown, branched 9 times and decreased in diameter to 3/8 of an inch within a distance of only 2 feet. The longest lateral root measured was 42 feet, but many others only slightly shorter grew into cultivated, unoccupied soil.

The vertical roots of the mulberry did not penetrate the soil as deeply as those of Asiatic elm, Osage orange and red cedar. The deepest root excavated was 12.5 feet, with only a few roots completely penetrating the calcareous layer (Fig. 3). Many of these roots grew directly downward to the top of this layer and there turned abruptly and followed along the top of the layer from 5 to 15 feet.

The lateral root systems of 18-year-old, well-cultivated thornless honey locust (*Gleditsia triacanthos inermis*) completely occupied the soil in which they extended. The longest lateral root extended 28.2 feet from the crown into cultivated soil. Depth of penetration of vertical roots of the living tree was slightly over 11 feet and the deepest root found under a drouth-killed tree was slightly less than 7 feet. The root system of the dead tree spread over 480 square feet, and the

TABLE 3

A COMPARISON OF THE NUMBER AND PERCENTAGE OF LATERAL ROOTS AT DIFFERENT LEVELS OF VIGOROUS AND RETARDED TREES

Soil horizons	Asiatic elm Vigorous		Asiatic elm Retarded		Russian mulberry Vigorous		Russian mulberry Retarded		Seedling apricot Vigorous		Seedling apricot Retarded		Osage orange Vigorous		Osage orange Retarded		Red cedar Vigorous		Red cedar Retarded	
	No.	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
1st foot	259	60.5	64	47.1	95	42.0	28	23.7	26	20.6	7	8.3	101	49.5	30	39.0	184	68.7	60	60.0
2nd foot	104	24.3	29	21.3	72	31.9	62	52.5	64	66.7	60	71.4	56	27.5	27	35.1	45	16.8	23	23.0
3rd foot	57	12.3	37	27.2	41	18.1	21	17.8	12	9.5	9	10.7	37	18.1	16	20.8	39	14.6	17	17.0
4th foot	8	1.9	6	4.4	14	6.2	5	4.2	4	3.2	8	9.5	10	4.9	4	5.2	...	...	...	...
5th foot	...	...	...	...	4	1.8	2	1.7	...	...	...	...	...	...	...	...	...	...	...	...
Total No. of roots	428	...	136	...	226	...	118	...	126	...	84	...	204	...	77	...	268	...	100	...
Percentage	...	...	...	31.8	...	...	...	52.2	...	...	...	66.7	...	...	...	37.8	...	...	...	37.3
Retarded																				
Vigorous																				

root system of the live tree spread over 369 square feet. The tree with the most extensive and shallowest root system died during the drouth, but the tree with the smallest and deepest root system survived. Apparently trees with this combination of wide-spreading lateral roots and deeper-penetrating vertical roots withstood the severe climatic conditions better.

The longest lateral root of seedling apricot (*Prunus armenica*) extended 32 feet from the crown and branched only four times. In competition with weeds these roots grew very little, but in cultivated soil they grew vigorously. The roots from one tree that came in contact with an uncultivated fence row changed their direction and continued to grow at approximately right angles in the cultivated soil. The roots were brittle, lustrous, red and rather small with many fine feeders. The deepest root penetrated to 7.7 feet, but the majority were in the first 6 feet of soil.

Ash (*Fraxinus* sp.) had a wide-spreading lateral root system, as shown in Figure 4. The longest root was 42.5 feet. The roots were grayish brown, light in weight and rather brittle. These roots did not penetrate the calcareous layer at any place for more than 17 inches and the deepest-penetrating root was 6 feet from the surface. Because the trees excavated had died during the drouth or had been severely damaged, the species of ash could not be identified. For this reason, more data on ash roots should be obtained before definite conclusions are drawn.

The western black walnut (*Juglans rupestris*) grown in an open cultivated field formed a very vigorous, lateral but shallow root system. The area covered by the whole root system was 816 square feet and the longest root extended 52 feet. The deepest root penetrated 5.6 feet, but not one penetrated the calcareous layer more than 20 inches. However, the living tree roots seemed to utilize most of the upper part of this layer.

Soil Moisture.—When the pits were being dug, it was noticed that the soil occupied by the roots appeared drier. This suggested that the trees were depleting the soil moisture. Therefore, to verify this observation, the percentage of total soil moisture in the root area of the different plantations and adjacent fields was determined (Table 4). In all cases the moisture content was found to be less under the tree than in the unoccupied soil. This would indicate that the precipitation is not great enough to replenish the moisture needed by the tree for normal growth. According to Finnell (2) only 18 per cent of the rainfall is available for plant growth. Since the average annual rainfall at the Panhandle Agricultural Experiment Station for the last 6 years was only 13.18 inches, the average available for these trees was only about 2.5 inches. Apparently the trees lived on the moisture stored in the soil before they were planted. These data and the dead and weakened condition of the trees in the shelterbelts indicate that about all of the available moisture in the root zone has been depleted. Because the total rainfall under normal conditions (2) rarely saturates the soil to 6 feet, it is highly important that additional run-off water be available to insure successful tree production in the southern high plains.

The decrease in moisture content of the soil in various plantations indicates that deep-rooted species utilize moisture below the calcareous layer. The shallow-rooted species on the other hand use only the available moisture from the upper few feet of the soil (Fig. 5). When the percentage of moisture in the soil under elm and Osage orange is compared with that in adjacent cultivated land, it is evident that these trees have used the moisture to a considerable depth. Between a row of elm and mulberry the

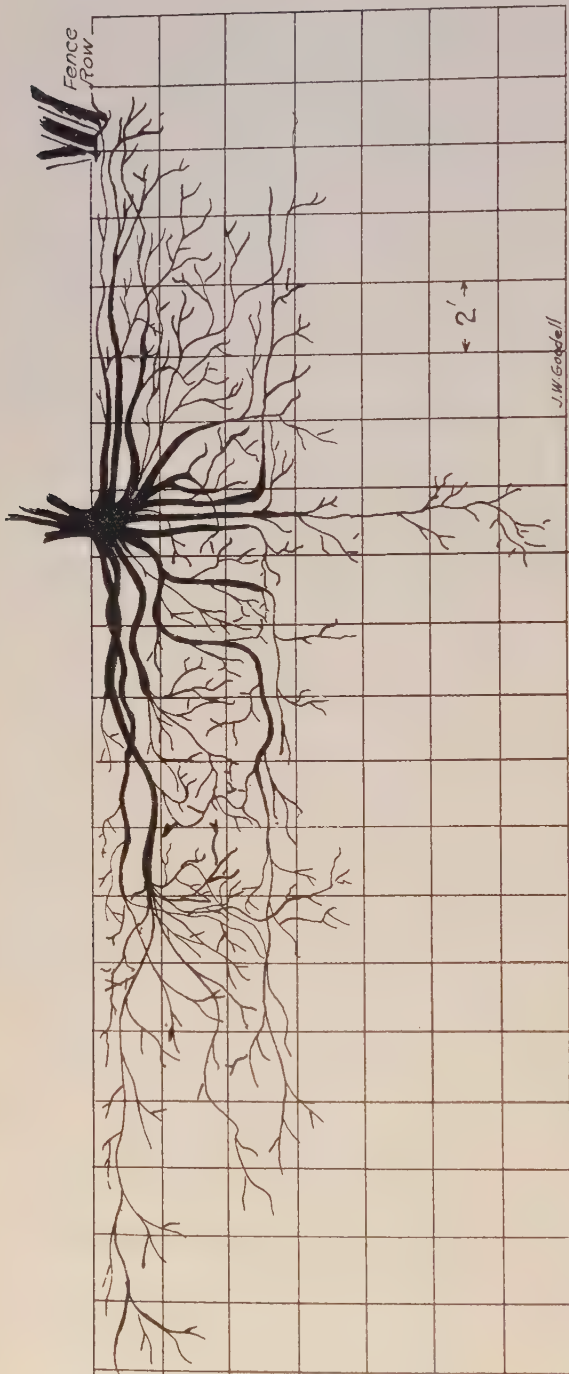

Fig. 3.—Russian mulberry root system in Richfield soil with zone of heavy calcification at six feet in depth into which few roots were able to penetrate. The roots also failed to penetrate the uncultivated fence row on the right, the greater growth being into the cultivated soil on the left.

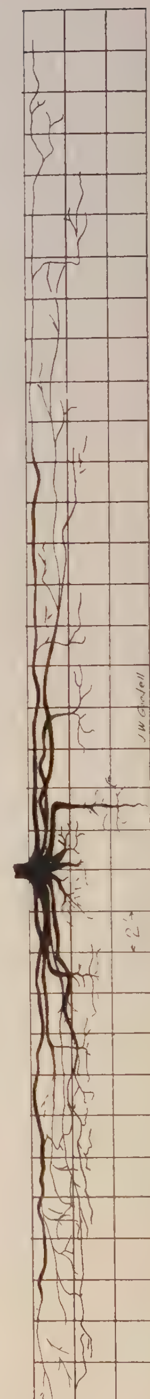

Fig. 4.—Root system of 21-year-old ash, growing in cultivated Richfield silt loam soil which was extremely dry throughout the area of root occupation. Moist soil was encountered directly below the root zone the trees all dying without utilizing this moisture.

oil moisture at a depth of 5 to 11 feet as less than between a row of elm and sage orange. This was the result of e large number of mulberry roots at is depth. Under a single row of apricot e moisture content was extremely low t 5 feet below the surface, but at 8 to 20 et the percentage was only slightly less an in the cultivated soil. The decrease the amount of moisture below the zone f root concentration probably was due the extremely dry soil in the root area bsorbing the water that might otherwise ave percolated downward. The higher oisture content near the surface un- oubtedly resulted from the scanty cur- ent rainfall.

The data given in Table 4 show that there was less moisture in the soil throughout the root area. The deep-rooted trees reduced the moisture content of the soil to the full extent of the excavation and the shallow-rooted trees took moisture only from the upper soil layers. By determining the moisture content of soils under many trees, it is hoped that it will be possible to establish the fact that moisture determinations can be used to measure the depth of root penetration.

Survival of Species.—In order to determine whether any relationship existed between various root depth classes and survival, the older plantings in the surrounding territory were studied, and in

TABLE 4

A COMPARISON OF THE SOIL MOISTURE PERCENTAGES IN THE TREE GROWTH AREA AND IN ADJACENT CLEAN CULTIVATED SOIL, AVERAGE OF 2-4 MOISTURE DETERMINATIONS IN EACH CASE

Depth Feet	Cultivated field Check	2-Row plantation elm and Osage orange	3-Row plantation between elm and mulberry	3-Row plantation in cedar row	Single row elm	Single row apricot
			Percentage of moisture			
2	16.5	11.0	12.8	10.8	10.2	15.0
5	17.9	11.3	6.5	9.2	9.8	3.4
8	16.4	6.9	4.7	3.5	8.5	12.5
11	11.9	6.9	5.1	9.9	7.3	9.2
14	12.8	6.8	9.6	12.5	6.5	11.6
17	10.9	5.4	9.3	10.1	8.1	10.8
20	10.5	6.8	9.3	10.7	8.6	10.6
23	12.4	8.2	9.6	7.5	—	—
26	12.5	—	—	8.5	—	—
29	13.0	—	—	—		

TABLE 5

SURVIVAL IN OLD SHELTERBELTS AFTER THE DROUTH OF 1930-1937

Name	Trees alive at beginning of drouth	Trees alive in 1937	Survival
eep-rooted trees	*Number*	*Number*	*Per cent*
Red cedar	540	480	86.9
Asiatic elm[1]	256	197	76.9
Osage orange	2.276	1,479	64.9
Black locust[2]	1,182	538	45.5
edium-rooted trees			
Honey locust	1.156	520	45.0
Russian mulberry	1.505	495	32.8
allow-rooted trees			
Ash	429	107	24.9
Seedling apricot	170	36	21.2
Western black walnut	241	50	20.7

[1]Windbreaks 10 years or older.
[2]Severely damaged by borers.

order to cover fully all conditions under which trees must live in this area, data were gathered on shallow and deep soils, cultivated and uncultivated areas, and moist and dry sites. Older trees were studied in order to avoid drawing conclusions from trees that had not become established. Undoubtedly shallow- and deep-rooted species would not show any variations in survival before the roots of deep-rooted trees penetrated to greater depths.

Trees in this region are very short lived compared to those in humid regions. Here 30-year-old trees appear matured. Under similar site conditions shallow-rooted

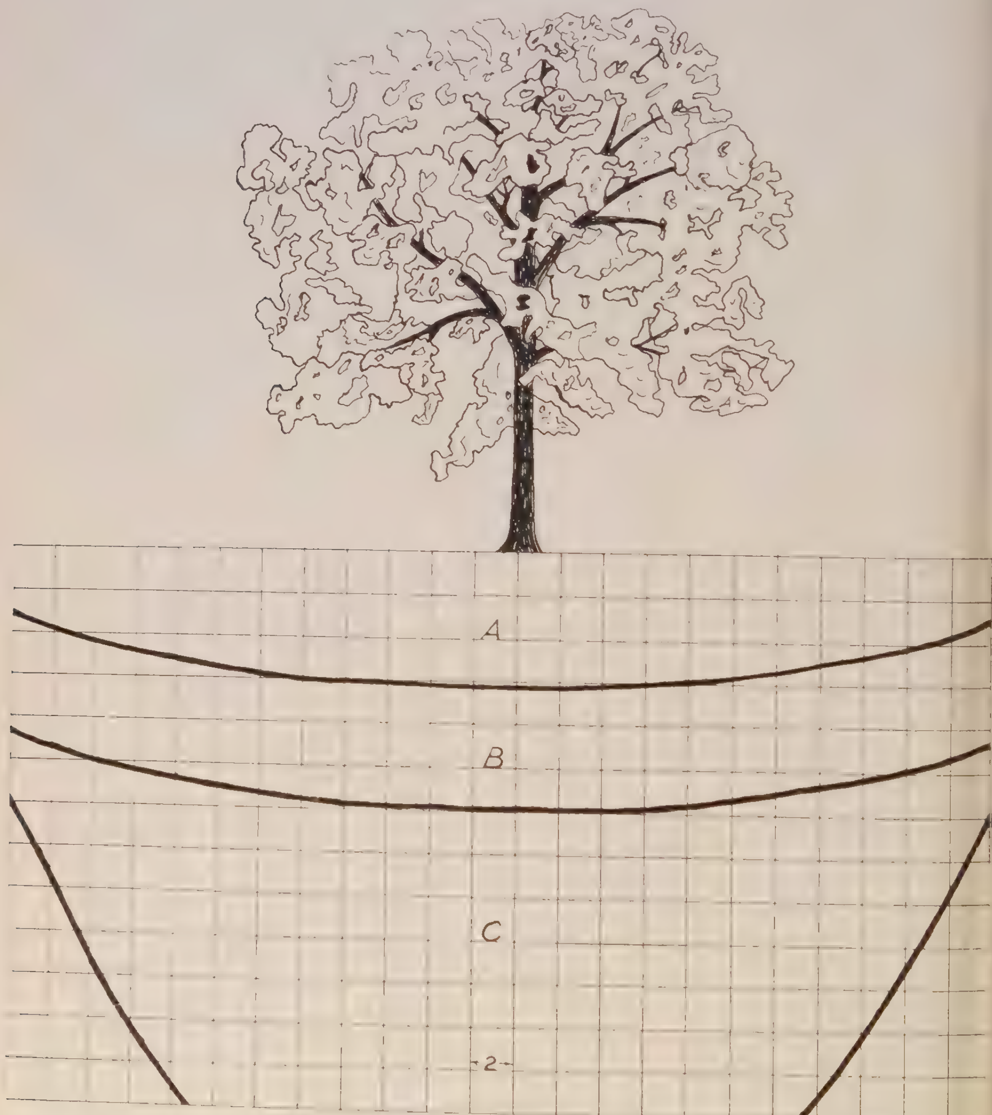

Fig. 5.—Diagrammatic drawing of the zones of soil available to the tree: (A) species having shallow, (A+B) intermediate, and (A+B+C) deep-rooted characteristics.

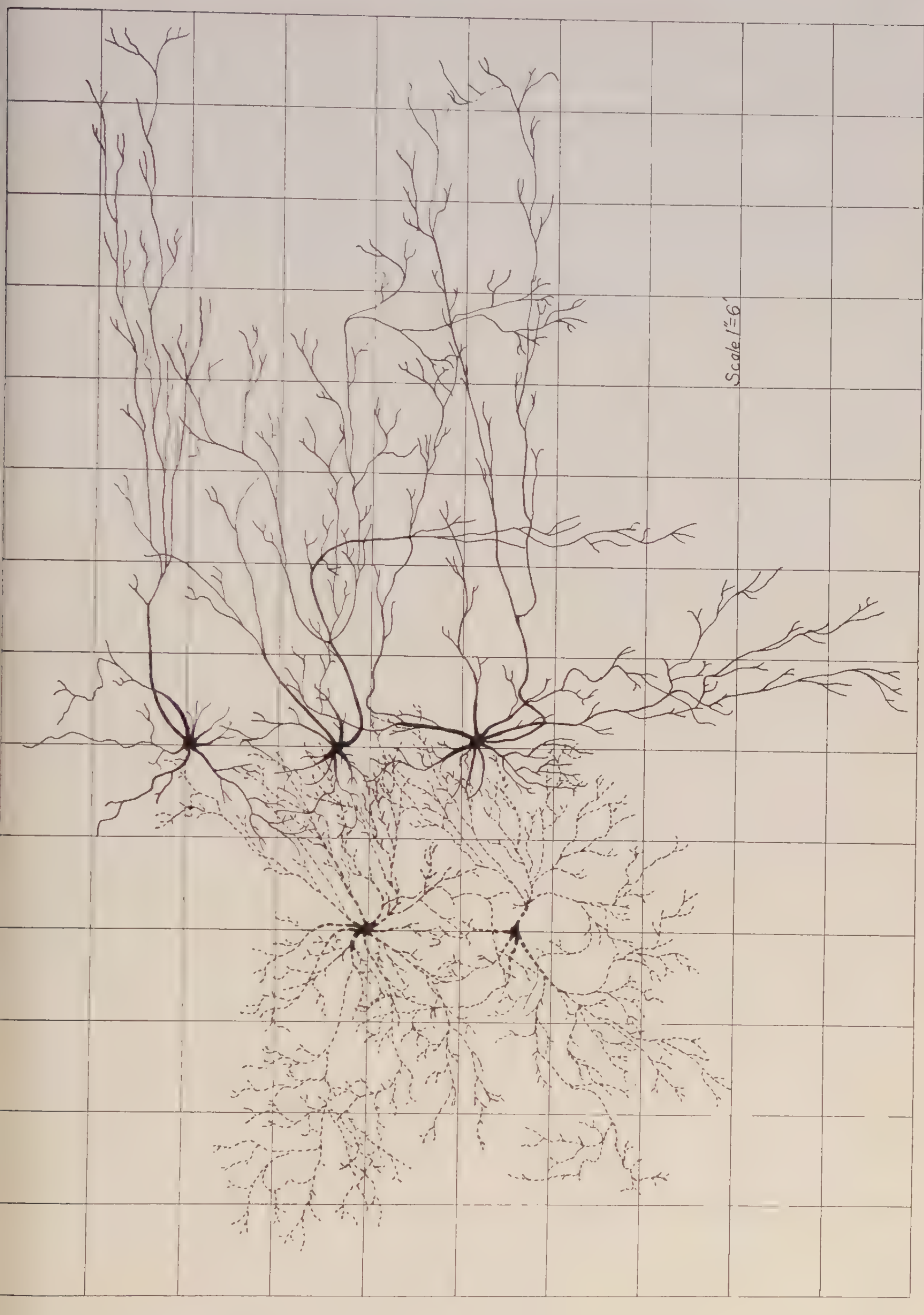

Fig. 6.—Drawing of horizontal roots of a portion of a two-row 9-year-old planting of Asiatic elm (right) and Osage orange (left). Note the interlacing of the roots of these deep-rooted species. The amount of interlacing of the two species and of the individuals of each was approximately 29 per cent.

trees showed more pronounced signs than the deep-rooted trees of maturity and decadence. Table 5 shows the survival of the various species studied. These figures show that a greater percentage of the deep-rooted and medium-rooted trees survived. Approximately 22 per cent of the shallow-rooted trees, 38 per cent of the medium-rooted trees, and 68 per cent of the deep-rooted trees survived. The length of life and survival of two of the deep-rooted species studied cannot be conclusively compared with that of other groups because Asiatic elm was introduced only recently and black locust was severely injured by borers.

Discussion and Conclusions

In the southern high plains region rainfall is not adequate to support a continued tree growth. The short length of life of trees is due (8, 11, 12) to the exhaustion of the moisture stored in the soil before the trees were planted. Shallow- and medium-rooted species, such as apricot and Russian mulberry, died soon after the available moisture in the upper horizons of soil had been exhausted. Trees planted where water accumulated and stood for short periods after rains showed few or no signs of maturity unduly early. This would indicate that planting sites should be selected where run-off water naturally accumulates, or can be accumulated by means of terraces or other engineering improvements. If the selected planting site is sod, it should be summer fallowed two seasons before the trees are planted to eliminate root competition and to allow moisture to accumulate and penetrate the soil.

In a semi-arid region the proper spacing of individuals in windbreaks is very important because the roots require a large area of soil to obtain sufficient moisture. In 2-row plantations of elm and apricot, elm and Osage orange (Fig. 6), and in a 3-row plantation of elm, mulberry and red cedar, the roots interlaced approximately 27, 29 and 33 per cent, respectively. This overcrowding of the roots was so great that some trees died, and as the trees and roots grow larger this root competition will become more severe. Adequate information is not available on which to base definite recommendations for the best spacing of trees in order to obtain the most vigorous growth and lowest mortality over the longest period of time. The data obtained, however, showed that the spacing used in a 3-row windbreak set in rows 10 to 12 feet apart and 10 feet in the row is too close. Although windbreaks having wide spacing will provide little protection soon after planting, the shallow rooted trees should not be spaced closer than 20 by 20 feet unless supplemental run-off water is supplied. However, the protective influence may be increased by staggering the trees. Shallow-rooted and medium-rooted species that depend upon extensive lateral spread to obtain moisture should be spaced farther apart than deep-rooted species.

Summary

1. The roots of Asiatic elm, Osage orange, red cedar and black locust were observed at depths of 24.5 to 27 feet. The roots of Russian mulberry and thornless honey locust penetrated only to 11 to 12.5 feet. The roots of seedling apricot, black walnut and ash penetrated to 5.5 to 7.5 feet.

2. Deep-rooted species obtain soil moisture to great depths as well as extensive distances close to the surface when the roots are not in competition with other roots. When competing with other roots, the lateral root systems are greatly reduced.

3. Shallow- and intermediate-rooted species obtain moisture only in the upper soil horizons and mature at an early age unless they occur in moist sites.

4. The age at which a tree matures n the high plains depends upon the available moisture.

5. Deep-rooted trees mature at a later age than shallow-rooted trees under like conditions.

6. Shallow-rooted and deep-rooted trees should not be planted together, owing to the more gregarious habits of the deep-rooted species.

7. Observations indicate that in the high plains region trees should not be spaced closer than 20 by 20 feet to obtain the most vigorous growth. Closer spacing can be used in sites having moisture accumulation.

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BRIEFER ARTICLES AND NOTES

Handbook for Journal Contributors

A 32-page booklet, *Suggestions for Contributors to the Journal of Forestry*, is being published by the Society to aid authors in the preparation of manuscripts. It will be sent free to members upon application to the Society's executive office. The cost to non-members is 25c postpaid.

The booklet was written by Henry E. Clepper, managing editor of the Journal, and contains a foreword by the editor-in-chief. It is designed to assist writers to prepare papers in conformity with Journal standards, and outlines the rules of procedure which authors are asked to follow in copy submitted for publication.

Publication of the booklet was authorized by the Council, but in order to keep down expense one thousand copies only have been printed. It is believed that this limited edition will adequately supply past and prospective contributors.

It will be appreciated if, when writing for your copy, you enclose 3 cents in stamps to cover the cost of mailing. All requests should be directed to the Society headquarters in Washington, D. C.

Henry Schmitz,
Editor-in-Chief.

Report of the Committee for the Revision of the Journal of Forestry Southern California Sub-Section

The Committee for the Revision of the Journal of Forestry was appointed at the November 1937 meeting of the Southern California Sub-Section of the Society of American Foresters. The initial report was presented to the sub-section at its February 1938 meeting. In subsequent meetings the proposals suggested were considered in considerable detail, and at the April meeting the committee was directed to re-write the original report in accordance with the sentiments of the sub-section as a whole. The revised report follows.

In the September 1937 issue of the Journal of Forestry is an editorial outlining the difficulties encountered in editing the Journal and an implied welcome of suggestions for its improvement. This committee is taking advantage of this editorial by presenting its report.

The importance of the Journal to the forestry profession cannot be over-emphasized. It is, first, the official organ of the profession, and in this capacity its standards reflect the standards of its members. Its editorials and articles demonstrate the policy of the profession and active cooperation should be given the editorial staff to keep these policies truly representative of the membership. It is the only research journal of the profession published in the United States and its pages reflect the progress of forestry research. And, to the forester who is fi

rom city conveniences and formal Society neetings, it presents a means of keeping is technical knowledge up to date and eeping him in contact with the activities f the rest of the profession.

The forestry profession is broadly split nto administrative and research men, and he field they cover stretches from growng trees to insuring water supplies and nanaging wildlife. One journal cannot ope to include in every issue articles of pecific interest to every worker, and the ditors of the JOURNAL are to be comnended on their efforts to keep every hase of forestry work before the memership. The following recommendations re made in the hope that they will inrease the value of the JOURNAL to the Society as a whole.

The committee recommends:

1. That no attempt be made to reluce the quality or size of the JOURNAL n order to effect economies in the adninistration of the Society. Since the JOURNAL is the only tangible return to nany who belong to the Society, and since y its distribution, it represents the proession in all parts of the world, it is of reat importance that its standards renain high.

2. That the bibliography appearing in ach issue of the JOURNAL be increased in ize since, for many, it is the only means f discovering the appearance of new ublications. It is especially recomnended that reviews of foreign publicaions be increased as much as possible. Because of language difficulties, such reviews may afford the only opportunity or American foresters to find out how oreign agencies are dealing with related roblems. If space must be saved it would be better to decrease the length of eviews of domestic papers since they are eadily available. In many cases a short aragraph describing a new American ublication may be all that is required. From such an annotated bibliography nembers of the Society could decide which papers were of interest to them and should, therefore, be read in their entirety.

3. That articles which may arouse questions or upon which there may be controversial arguments be opened to discussion by members of the Society, this discussion to be published in the JOURNAL in several issues succeeding that in which the original article was printed.

This suggestion is made in appreciation of the interest shown in the *Proceedings of the A. S. C. E.* by members of the engineering profession and of the value of the "open-forum" type of discussion that follows articles published therein. We believe that the quality of articles published in the JOURNAL could be kept at a high level if the authors knew that their statements would be challenged and that interest in the JOURNAL would be heightened if members of the profession knew that their reactions to articles published in the JOURNAL could be expressed for the consideration of the rest of the profession. Such a plan would necessitate the allocation of some space to discussions with a corresponding reduction of space for articles, but we feel that the interest in and value of the discussions would far outweigh those articles whose printing must therefore be postponed.

The committee suggests the following procedure for the articles to be discussed: The author should submit to the editor with his article a list of three or four proposed commentators and as many extra copies of his manuscript. The editor will send a copy of the manuscript to each commentator with a request that the latter indicate if he will be willing or interested in discussing the paper after publication. A lack of interest on the part of the commentators might constitute grounds for refusal of the article by the editor.

Discussions of an article by the principal commentators should follow within a month or two of the publication of the

article and for some months after that, the time depending upon the interest shown, the article should be thrown open to general discussion. At the end of the discussion period the author should be permitted to reply to his critics.

In order to conserve space and to discourage irrelevant remarks, discussions should be limited to 1,000 words. If a writer has enough data to support a longer discussion, it is possible that it can stand as an article in its own right.

The three suggestions given above are respectfully submitted to the editorial staff of the JOURNAL OF FORESTRY by the Committee for the Revision of the JOURNAL OF FORESTRY of the Southern California Sub-Section of the Society of American Foresters.

H. G. WILM,
L. PERCEY,
GORDON VANCE,
EDWARD A. COLMAN,
Chairman.

HEARING ON RADIO COMMUNICATION IN FOREST PROTECTION

An informal hearing on the allocation of radio frequencies to state and private forestry agencies was held at the Federal Communications Commission in Washington June 29. E. L. White, engineer for the Commission, presided.

During the past few months, the Commission has been studying the problems involved in the use of radio communications in the protection of forested areas of the United States. Because of heavy demands in the use of the shortwave band, the possibilities of further allocations to forestry agencies of frequencies in this portion of the radio spectrum were said to be very limited. According to the Commission, no frequencies in the 2500-3500 kilocycle band are available for exclusive allocation, and there exists only the possibility of sharing frequencies already assigned, when interference can be avoided. Shortwave frequencies now allocated to the federal Forest Service are all on a shared basis. This portion of the spectrum is congested by heavy demand for use by aviation, point-to-point communication, and by the Army, coast guard, and other government agencies.

In the ultra-high range, however, provision has been made for the use of ten frequencies for forestry stations for radio communication necessary for the prevention and suppression of forest fires. This is a new service, according to the Commission. The frequencies allocated to use by forestry agencies are:

kc	kc	kc	kc
30,940	31,340	31,580	31,940
35,740	35,940	37,460	39,420
39,740	39,940		

Applications for assignment of these frequencies will be received by the Federal Communications Commission up to October 1, 1938. It is expected, the Commission said, that all existing experimental licenses will be converted to permanent licenses by that date. Licensees and applicants were requested to arrange for the proper choice and use of frequencies to minimize interference, and to file agreements on these matters with the Commission.

On June 22, the Commission promulgated new rules and regulations covering emergency service and providing for the permanent allocation of frequencies between 30,000 and 60,000 kilocycles, which include those allotted to forestry stations. Following are rules of special application to forestry agencies:

Sec. 110.08 *Forestry station.* The term "forestry station" means a station used for communications necessary for the prevention and suppression of forest fires.

Sec. 111.04 *Forestry stations.* Authorization for forestry stations will be issued to municipal, state, or private organizations which are legally responsible for the protection of forest areas.

Sec. 111.27 *Assigned frequencies non-exclusive.* No frequency available to a station in the

emergency service will be assigned exclusively to any applicant. All stations in this service are required to coordinate operation so as to avoid interference and make the most effective use of the frequencies assigned.

Sec. 118.01 *Scope of service.* Forestry stations, although licensed primarily for communication with mobile forest fire fighting units, may transmit emergency messages to other mobile units such as fire department vehicles, private ambulances and mobile police units in those cases which require cooperation or coordination with forestry service activities. In addition, such stations may communicate among themselves provided: (1) No interference is caused to mobile service and (2) Only those communications are transmitted which are necessary for the operation of forestry service.

Sec. 118.02 *Power; modulation.* The maximum power to be assigned for the use of forestry stations shall be 50 watts. The transmitters of forestry stations shall be modulated not less than 85 per cent, nor more than 100 per cent on peaks.

Other rules, applicable to police, marine fire, special emergency stations, and other emergency services, as well as to forestry stations, covered procedure in making applications for licenses, frequency tolerance, frequency measurement, tests of equipment and service, license periods, operators' licenses, logs, and inspections. Copies of the rules of June 22, 1938, governing emergency radio services, may be obtained from the Federal Communications Commission, Washington, D. C.

Representatives of state forestry departments attending the hearing included: C. D. Haigis, New Jersey; H. G. Weber, Minnesota; K. F. Williams, New York; E. J. Vanderwall, Wisconsin; George W. Wirt, Pennsylvania; D. Robson, Michigan; J. W. Ferguson, Oregon; Wm. Hoos and Walter J. Quick, Jr., Maryland; H. L. Baker, Florida.

Also present were the following members of the U. S. Forest Service: A. G. Simson, C. R. Tillotson, E. M. Bruner, A. G. Hamel, A. B. Hastings, W. F. Squibb, E. H. MacDaniels, D. W. Beck, and Edward Ritter.

Among others attending were L. P. Clark, Raymond Posen & Co., Philadelphia; C. E. Randall representing the Society of American Foresters; W. M. Oettmeier, Superior Pine Products Co., Fargo, Ga.; E. J. Girard, Federal Telegraph Co., R. D. Campbell, American Telephone and Telegraph Co.; C. E. Pfautz, Radio Corporation of America; J. W. Martin, Southern Railway Co.; M. G. Shrode, U. S. Coast Guard; W. J. Kelley, Temco Transmitters.

C. E. Randall,
U. S. Forest Service.

Vegetatve Propagation of White Pine As a Possible Method of Blister Rust Control

In a recent article the writer[1] mentioned the possibility of developing a rust-resistant pine strain, provided two prerequisites are satisfied. First, it is necessary to find out if certain trees are immune to blister rust. Such immune trees, if multiplied, may give rise to rust-resistant progeny. If seed is collected from such immune trees, the progeny may not necessarily be immune, since the pollen parent might be rust-susceptible. Such a case actually happened in an experiment conducted by Dr. W. N. Snell of Brown University. Dr. Snell collected seed from a well known resistant pine at Temple, N. H., and inoculated trees grown from the seed. "The trees from the resistant pine were not more resistant than trees from normal seed. Of course, it must be kept in mind that no one has any information regarding the staminate parent in the production of these seeds, but it is extremely likely that the pollen entering into com-

[1]Mirov, N. T. Application of plant physiology to the problems of forest genetics. Jour. For. 35:840-844. 1937.

bination came from susceptible parents for the most part."[2]

It follows that if undesirable consequences of sexual reproduction in this case could have been avoided, there might have been more hope for development of a rust-resistant strain. The rust-resistant progeny could be obtained asexually either by parthenogenesis or by vegetative propagation. In both cases the possible undesirable contribution from the pollen parent is removed. The second method appeared to be much simpler than the parthenogenetic production of seeds, provided it be possible to take cuttings from immune mother trees and to root them.

The propagation of pines from cuttings, in general, is a problem which has never been thoroughly investigated by foresters; at least the author knows only a few instances in which rooting of pines from cuttings has been reported. Field[3] described recently in a little known New Zealand forestry magazine his ten-year-old plantation of Insignis (Monterey) pine on sand dunes, established simply by planting stripped twigs of the pine in the permanent location. This success in growing a pine from slips is an exception, and judging from Mr. Field's letter to the writer, it is due to exceptionally favorable external conditions: abundance of precipitation, mild temperatures prevailing during the period of rooting, and a uniformly moist rooting medium (sand) in which the water table was maintained at only one foot from the surface, probably by the nearby presence of a pond. Balfour[4] reported root development in *Pinus austriaca cuttings.* Kurdiani[5] successfully rooted cuttings of *Pinus sylvestris.*

In the course of my experimentation with pine cuttings, during which Field's results with Monterey pine were verified, and ponderosa pine cuttings as well were successfully rooted, some attempts have also been made to root cuttings of eastern white pine (*Pinus strobus*). The 3- or 4-inch-long branches were cut in December from ten-year-old trees growing at the University of California nursery in Berkeley. Since the accumulation of oleoresin on the cut surface is not desirable, the cuttings were kept with their ends in warm water for two hours in order to drain from them as much oleoresin as possible. The cuttings were then planted in coarse sand in electrically heated propagating frames, where the temperature of the sand was maintained between 74-78° F. Roots of a very peculiar type appeared by the end of May. The primary roots were about 3 mm in diameter, growing horizontally, without branching, for a length of 2-3 inches. Considerably finer secondary roots emerging vertically appeared later.

In these preliminary tests, it was proved that the vegetative propagation of eastern white pine is perfectly feasible physiologically, and this fact seems to open new hope for the rapid development of a white pine strain which may be immune to blister rust.[6]

N. T. Mirov,
California Forest and Range Experiment Station.

[2]Quoted from Dr. Snell's letter.

[3]Field, J. F. Experimental growing of Insignis pine from slips. Te Kura Ngahere 3:185-186 1934.

[4]Balfour, I. B. Problems of propagation. Journ. Royal Hort. Soc. 38:447-460. 1912-1913.

[5]Kurdiani, S. On vegetative propagation of forest trees by cuttings. Lessnoi Zhurnal 38:3 March, 1908 (In Russian).

[6]Subsequent to the writing of this report, the writer has been informed by John H. Murray of Marsh Botanical Garden that he also has been successful in rooting cuttings of *Pinus strobus.*

New Two-Way Radio for Fire Fighting Vehicles

The U. S. Forest Service has developed a new two-way radio communication unit adapted for use in fire trucks and cars.

Vehicles used in fire fighting or patrol in national forest areas will soon be equipped with the new radiophone device so that forest rangers and other officers can keep in touch with their headquarters at all times. In the past, men on the way to fires have been out of communication with their base station. Portable Forest Service radio equipment now in use can be set up only after stopping. Many minutes or even hours may elapse, during the run to a reported fire, before the fire fighters set up the portable outfits or otherwise reestablish contact.

The new equipment will permit fire chiefs to dispatch trucks on long distance runs and transmit details as to the exact location of the fire while the truck is on the road. The dispatcher also can recall fire fighting equipment or re-route it to a more dangerous or more recently reported fire. Long and uncertain runs may thus be eliminated, an important item in very hazy or bad fire weather.

Work on the new device has been carried on by A. G. Simson, radio engineer of the U. S. Forest Service, and associates. They have perfected a way to use the regular short wave instead of the ultra-high frequencies used by police cars and others on patrol duty for two-way communication. The new unit permits a greater communication range than the ultra-high frequencies.

The transmitting range of the new unit under adverse conditions is at least 25 miles. Tests under favorable conditions show the outfits to have a range up to 250

Photo by U. S. Forest Service

Fig. 1.—U. S. Forest Service mobile antenna matching unit used in two-way communication in 3,000 KC band.

and even 500 miles. These distances are exceptional when it is considered that the antenna used is only a 7-foot metal fish pole of the ordinary hardware store variety, costing about 60 cents. The Forest Service recently tested the new radiophone device by talking from Portland, Oregon, to Reno, Nevada, and distances beyond, with excellent results.

The outstanding feature of the apparatus is a small iron box containing the matching unit which permits unusual efficiency in transferring energy from the transmitter to the antenna and, conversely, from the antenna to the receiver. A coil and condenser combination is used to adjust the impedence of the antenna to the transmitter so that they are brought in perfect tune, thus insuring maximum transfer of radio energy.

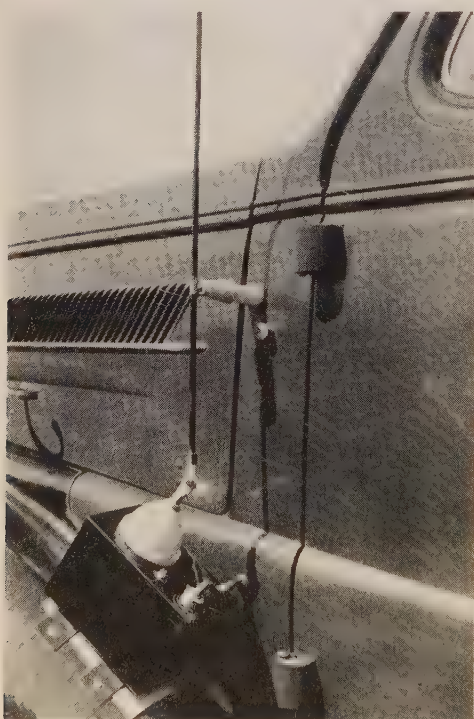

Photo by U. S. Forest Service

Fig. 2.—Experimental installation of U. S. Forest Service mobile transmitter for use in 3,000 KC band.

The new mobile radio will be made available also to fire fighting forces protecting state and private forest lands.

The Forest Service type of smaller ultra-high-frequency outfits weighing only eight pounds will continue in use in the back country where foresters travel with horses or on foot to reach fires or render aid to floods and other disasters.

Determination of the Rate Earned on a Forest Property

The literature on the determination of the rate earned on a forest property has, for the most part, dealt with single even-aged stands of timber. The method known as the determination of the mean annual forest per cent was first published, in English, by Sir William Schlich in 1904, in a pamphlet, but was not included in his famous Manual until 1922. In 1914, Chapman published a method of determination by trial and error.[1] A much superior graphic method, which proved to be that advocated earlier by Schlich, was published by W. E. Hiley in 1919,[2] and with his permission, was described by Chapman in 1926.[3]

This graphic approach still dealt with even-aged stands, though applicable to any forest property whose cost at a given date could be determined by a sale or appraised. The method is illustrated in Figure 1 by the descending curves labelled gross capital value, and capital value less taxes. It consisted of determining the capital value of the property for the year of origin or appraisal, by the usual formulae, by successively higher rates of

[1]Chapman, H. H. Forest valuation. John Wiley and Sons. 1914.
[2]Hiley, W. E. The mean annual forest per cent. Quar. Jour. For. 13:156-165. 1919.
[3]Chapman, H. H. Forest finance. J. B. Lyon Company, Albany, N. Y. 1926.

nterest. From the curve plotted through hese points, the rate which will be earned can be found for any given purchase price or cash value in year of origin or purchase. In January, 1938, the method was improved by the author so as to permit a simple determination of the rate of compound interest or discount which is applicable to a forest property composed of many different stands, acquired and managed over a period of years, and from which future income is expected which may in turn take any form provided it can be appraised as to time and net income.

This improvement consists of computing *both* the cost value and the capital value of the property as a whole, to the pres-

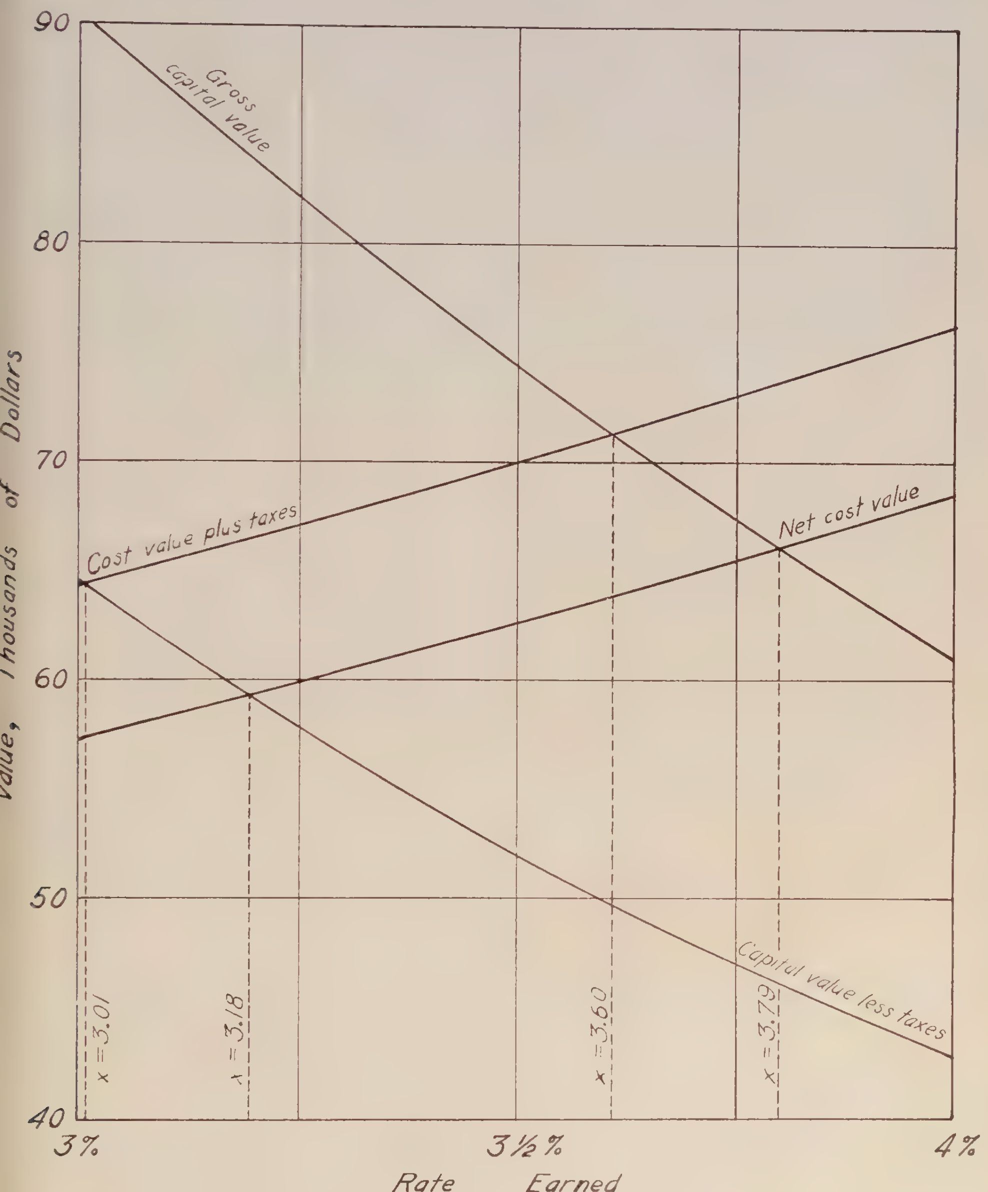

Fig. 1.—Improved graphic method of determining the rate earned on a forest property.

ent year. Cost value is taken from the books of the owner and may be calculated with complete accuracy if the records are kept and each year's operation is separately recorded. Capital value is always an appraisal, of which the sale value of the property is an example. It can be based, as usual, on appraisals of future income and costs for the forest, extended to infinity. Both the cost value and capital value are then computed for a range of interest or discount rates and separate curves are plotted, one for cost value and one for capital value, showing these values over the respective interest rates. The cost value curves ascend with higher rates. At the point where the two curves cross, the rate which will be earned on the enterprise is indicated.

In Figure 1 these calculations were made with past and future taxes, and without taxes. The two significant points are, earnings of 3.18 per cent with taxes, and 3.79 per cent exclusive of taxes. This indicates that if all cash costs incurred in the past and the future were computed to the present by these rates of interest, the cash income would return these cash costs and interest. The method is of universal application to all forms of forest investments, and depends for its accuracy on the ability to ascertain or appraise the cash items involved and the times of payment.

The problem for which this diagram is a solution is as follows:

	Cash costs			Annual taxes	
Capital expenditure	1913 -	$10,000		1913-22	$100.00
	1919 -	5,000		1923-32	250.00
Maintenance	1913-20	500	annually	1933-37	350.00
	1921-30	800	annually		
	1931-37	300	annually		
Net future income					
	1938-47	1,000	annually	1938-47	500.00
	1948-57	2,000	annually	1948-57	500.00
	1958-67	3,000	annually	1958-67	1,000.00
	1968-	4,000	annually	1968-	1,000.00

Calculated values	3 per cent	3½ per cent	4 per cent
Cost without taxes	$57,325	$62,700	$68,570
Cost with taxes	64,289	70,034	76,281
Capital value without taxes	64,438	51,907	42,775
Capital value with taxes	90.333	73,371	60,975

The author is not aware of any previous publication of this revised method (as was the case cited above with Sir William Schlich). If it exists he would appreciate the reference.

H. H. CHAPMAN,
Yale University.

A CORRECTION

In Table 1 of the article "Tools and Methods in an Experimental Pruning of White Pine," by Wm. Mollenhauer, Jr., in the June 1938 issue of the JOURNAL, a footnote was appended in which J. G. Geddes of H. K. Porter, Inc., defended the use of one of the tools.

The author wishes it made clear that the footnote was in no way a part of the original article and that the views stated in it are not accepted by him.

FURTHER NOTES ON SHIPMAST LOCUST

The three articles on shipmast locust appearing in the JOURNAL for August 1937 serve to focus well deserved attention on this very valuable locust variety. The inference to be gained from these articles is, that this particular strain of black locust is confined to Long Island. My own observations covering the last ten years, would tend to indicate that such

not the case. In fact, it would be sur-ising if a tree with all the virtues that ve been indicated in Mr. Hick's account black locust referred to by Mr. Det-ler,[1] should escape distribution as the cord of its performance was spread om pioneer to pioneer. Certain it is at all up and down the Hudson Valley ere are stands of locust that have all e ear marks of the shipmast variety. ie form, the habit, the bark, the lack seed, the resistance to borer—all indi-te some relationship to Long Island icestors.

On the west side of the Hudson the ecimens or groups are fairly close to e river (none found more than ten miles stant). On the eastern side, stands clear- of a shipmast variety are found almost the state line. This is not surprising nce this whole section, comprising what e now Dutchess and Columbia Counties, as settled early in Colonial times. Trac-g this strain northward up the Hudson, is found on both sides of the river as r as Glens Falls (60 miles north of lbany).

Some unusually fine pole wood stands obvious root sucker origin are to be oted in Saratoga County. In fact, around d farm homes on both sides of the Mo-iwk in Saratoga and Schenectady Coun-es the fastigiate habit of these locusts conspicuous on the sky line. But chenectady County marks the western mit of these veterans. Continuing on up e Mohawk, one finds locust, to be sure, ound Little Falls and Herkimer, but they e newcomers of the elm habit type; all of them showing serious borer injury. In other words, it seems fair to deduce that the shipmast variety of locust was brought up the Hudson and as far west on the Mohawk as the white man dared to make a permanent home in those stirring days of constant warfare with the Iroquois Confederacy.

During the unprecedented winter of 1933-34 most of New York State experienced sub-zero temperatures for a longer period than in the previous 100 years.[2] What, if any, effect did these low temperatures have on shipmast locust? On Long Island the winter was not severe and the shipmast locust apparently suffered no ill effects. However, in Dutchess and Columbia Counties literally thousands of mature locusts, very obviously of the shipmast type, were winter killed in the tops. Today in driving out of Poughkeepsie in any direction one cannot fail to note these disreputable specimens—the tops gone and the lower half of the trunks covered with sprouts. For reasons that are not clear, the shipmast type of locust farther up the Hudson, particularly in Saratoga and Washington Counties, has shown little evidence of such severe winter killing.

It would seem from this general observation that these apparently hardier northern trees would be better adapted as stock for the propagation of cuttings, than those from Long Island, particularly if the cuttings are to be planted in the northern states.

J. A. Cope.
Cornell University.

[1]Detwiler, S. B. The history of shipmast locust. Jour. For. 35:709-712. 1937.
[2]Cope, J. A. Winter injury to hardwoods in 1933-34. Jour. For. 33:939-940. 1935.

REVIEWS

Wood Preservation. By George M. Hunt and George A. Garratt. *ix+457 pp. Illus. McGraw-Hill Book Company, New York, 1938. $5.*

Hunt and Garratt's book not only meets a long felt need in the class room, but also should be in the hands of all persons interested in the growth, manufacture, selling, and use of forest products.

The text opens with a brief discussion of wood as compared to its substitutes. This topic is further amplified in a later chapter, where many important details of value to prospective builders are considered. The authors point out that many types of structures which are planned to be permanent are frequently of no use after 20 to 25 years, owing to changing conditions. If they were made of timber there would always be a high salvage value, whereas other construction materials can rarely be re-used.

All of the important preservatives are described, proprietary as well as unpatented, together with information on the value of each. In explaining the preparation for treatment there is a very good portrayal of seasoning methods, but no attempt is made to clarify the controversial point concerning the proper moisture content for material to be treated. Instead of a definite statement regarding this there is a table showing the many variations in length of air-seasoning periods. The authors portray the many methods of applying preservatives, including not only the important present-day processes but also many that are no longer used. How various factors affect penetration and absorption of preservatives is adequately discussed.

If every potential user of wood for construction would read and digest the contents of the chapter "Economic Aspects of Preservative Treatment," the demands for treated timber would undoubtedly increase. This chapter strikingly brings out the many advantages of wood construction. The obsolescence of structures mentioned at the beginning of this review is discussed in detail. Another noteworthy point relates to the experience of the Memphis street railway, where the ties outlasted the original rails and were expected to support the new rails for the length of their life, about 20 years.

"Treating Plants and Equipment" is a chapter expertly handled. In describing equipment which the reader could conceivably construct for himself and use adequate information is given to make such construction possible. Realizing that treatment with standard wood preservatives is not the only means of lengthening the service of wood, Hunt and Garratt have included a chapter on other methods of protecting wood. Herein are set forth construction rules for hindering deterioration, means of protection against termites and methods of stain prevention.

The final chapter, on fire retardance brings out that fire prevention and quick suppression of fires that start will do more to decrease fire damage than will the type of construction. Descriptions of tests for fire resistance and of methods and treatments to make wood fire-resistant help to make the chapter worthwhile in the study of fire resistance of wood.

Only a few minor criticisms can be made of this book. Perhaps the most important one is that it would have been advantageous to have had at least parts of the manuscript reviewed by persons

o are immediately associated with the thors. Even though the reviewers are tirely competent, others might have de some valuable additions. Two or ee points are reiterated more often than cessary. This is particularly true of repeated statement that seasoning is necessary prior to treatment with the ucherie process.

Such criticisms, however, are more than set by the book's good points. In genl, throughout the entire book, descripns include information as to the effeceness of the process, preservative, or uipment that is being described. The ief introduction at the beginning of each apter helps to make the book better an average, because it gives in summary rm the contents of the chapter. Aner excellent point is the wide use of oss references. Finally, if the book ntained little besides the bibliographies the end of each chapter, it would still a valuable contribution in the field of od preservation.

HERBERT B. MCKEAN.

unicipal or Community Forests. Their Importance as a Source of Future Timber Supply, for the Conservation of Wildlife and for Recreational Use. By Herbert F. Prescott. *Conservation Department, Albany, N. Y. 1938.*

This is a revision of a publication by e same author issued in 1927. It prents interestingly and brings up to date e record of real achievement in reforestg and managing as community forests a nsiderable acreage of idle and abanned farm lands in New York State.

Owing to the educational and promonal efforts of the state conservation mmissioners, the superintendents of fors, and the extension departments at Corll and Syracuse, a great wave of enthusin was built up for planting such farm lands, which have generally been purchased for $3 to $5 an acre.

Beginning with the planting of the city watershed in Gloversville in 1909, the movement gained great impetus and widespread acceptance. This record indicates that more than 68 million trees have been planted in 579 community forests. These include 215 school district forests, 213 village forests, 50 city forests, 50 county forests, and 51 town forests. It is estimated that these forests comprise an aggregate area of approximately 140,000 acres. The name, date of establishment, and the number of trees planted on each forest are given. It is indeed a notable record of accomplishment.

Throughout the bulletin there are many interesting illustrations of when, how, and why these forests have been created. Practically every one of them has evolved from the civic-minded and forward-looking vision of some local individual or group. These community forests have not just happened. They are the direct result of the persistent efforts, energy, and enterprise of school superintendents and principals, individual members of boards of supervisors, watershed superintendents, city engineers, watershed engineers, or other citizens.

Today there are hundreds of examples of excellent plantations of white pine, red pine, Norway spruce, Scotch pine, northern white cedar, European larch, balsam fir, and some other species. Most of the planting has been done with conifers. Unfortunately, many of the Scotch pine plantations are not very successful, owing to the poor seed sown during the early years. Red pine and Norway spruce have generally made the most impressive showing. New York City has planted more than 5 million trees, Glens Falls more than 2.5 million, Little Falls about 2.5 million, and many other cities have planted from 50,000 to a million trees or more. Several counties have planted from 1 to 2.5 million trees each, notably Oneida, Oswego, Onondaga, Lewis, Jefferson,

St. Lawrence, Warren, Saratoga, Erie, and other counties.

W.P.A. labor has been used on at least 50 of these plantations. Professionally trained foresters are employed on a full-time basis on two of them. Many, especially those established before 1920, are in real need of thinning and pruning and other management plans.

The city of Little Falls has taken more than $26,000 from the sale of sawlogs and other timber products from its forest. Many of the forests are on a self-supporting basis.

The New York Conservation Department is to be congratulated upon its achievement in initiating and continuing this program of community forests. Its example should point the way for other communities to follow where similar conditions exist.

NELSON C. BROWN,
U. S. Forest Service.

The County Forests of Wisconsin. By F. B. Trenk. *32 pp. Illus. Wisconsin Conservation Department, Madison. 1938.*

After many years of struggling with tax-reverted lands, which have become such a serious economic problem in many states, Wisconsin has enterprisingly shown the way out of what had been an embarrassing situation in many sections of the northern part of the state. This 32-page bulletin tells the story of the evolution of a number of social and economic forces that have been attempting to find a satisfactory solution for many years.

County forests are one form of community forests, which have proven to be the most successful, popular, and profitable phases of the forestry program in many districts of Europe. We have a number of county, town, city, village, school district, watershed, and other forms of community forests in this country. One the most notable developments and o that has pioneered in the embarrassin and confusing morass of land-utilizatio problems, appears to be on the way to satisfactory solution in Wisconsin. Tre has interestingly and effectively portray this story in the bulletin, which shou show the way to other states that are co fronted with similar problems. It is i deed, as stated in the foreword, "A uniq adventure in popular forestry." With t land stripped of most of its original fore wealth and unsuited for tillage or oth agricultural effort, the people of the counties have taken advantage of the pr gressive and forward-looking act of 19 known as the Wisconsin Forest Crop La A new vision and a new opportunity see to be ahead. Many meetings, discussion arguments, and local elections have be held over the problems of this difficu land-utilization situation. These have r sulted in a warm personal interest in an understanding of the problems on the pa of the citizenry that perhaps could n have been brought about in any oth way.

Wisconsin has made a notable contribu tion to the development of communi forests in this country. According to th bulletin, there were 1,746,000 acres in county forests as of March 15, 1938. M of them were established between 19 and 1933. The individual county fores vary in size from 6,202 to 205,386 acre With the assistance of the Civilian Co servation Corps, 32,000,000 trees ha been planted on these forests, 23,2 acres of timber stands have been i proved, 3,336 miles of fire breaks co structed, and much other forest improve ment and construction work accomplishe

The bulletin is printed on excellent p per, the attractive illustrations are apt related to the descriptive material, and t style is very readable and interesting.

NELSON C. BROWN,
U. S. Forest Service.

ies grandis und ihre Klimarassen (A. grandis and its climatic races.) By Dr. Karl M. Müller. *118 pp. 45 figs., map. J. Neumann, Neudamm (Germany). 1938.*

German forestry is, from the American int of view, in more than one way a eer sort of forestry. This book is proof the fact. What American forester would ect *Abies grandis,* among all American ecies of trees, for the subject of a monraph comprising some 118 pages? And 10 would think of sending a specialist road, at a cost of several thousand llars, to study a species considered to inferior? As a matter of fact, the auor of the book was sent to the western ited States in 1930 by his government, on the solicitation of the University of unich and at the expense of the national ientific society, for a study of *Abies andis,* its various races, its technical posilities, and its natural enemies. After ending six months at the task, in which was much assisted by many American resters he has returned with a report at should be as interesting to American resters as it is to Europeans.

Dr. Müller distinguishes five natural ographic races of *A. grandis,* for each which he discusses the climate, the soil, e types and composition of forest, and e rate of growth. The text is illustrated th 45 excellent pictures taken in the imeval woods. The five races are disbuted as follows:

1. The western slope of the Cascades.
2. The eastern slope of the Cascades.
3. The Blue Mountains of Oregon.
4. The Selkirks of British Columbia d the west slope of the Bitterroots in aho.
5. The easterly Bitterroots of Montana.

In the author's opinion that race of *ies grandis* is best adapted for introction in the hills and mountains of Gerany which flourishes as a companion of stern white pine in the Bitterroots of aho. He believes that the climate of the western Bitterroots bears the greatest similarity to the climate of the German mountains. I cannot concur in this opinion for two reasons. One is my personal experience in Idaho and Montana as well as in the German mountains, and the second lies in a comparison of the climatological records of Germany and of northern Idaho. Without a doubt, if any American race of *Abies grandis* lives in a climate similar to that of Germany, it is the race found in western Washington at elevations of about 1,000 feet.

If we want to learn the truth about the possibilities of the species parallel plantations of its various races will supply the facts. I am sure that American foresters in the Northwest would give a helping hand to their German colleagues, if they were to attempt plantations of this character.

Technically, *Abies grandis* is no better a tree than is the European silver fir, *Abies alba* Mill. *Abies alba,* however, in the lower reaches of its German domain, is badly handicapped by insect pest (*Dreyfusia*). Whether or not *Abies grandis* is immune or resistant to this pest remains to be seen.

C. A. Schenck,
Darmstadt, Germany.

Milizia Forestale dal V al XV E.F. (The Forest Militia, from year 5 to year 15, Fascist Era). *Officino dell' Istituto Italiano d'Arti Grafiche, Bergamo. 1937.*

This pictorial summary of ten years' activities of the Italian Forest Service—Milizia Forestale—is unique. The story is told almost entirely by pictures, some of which are most attractive. The report opens with an almost life-sized, steel-helmeted portrait of Il Duce, and five other pages, out of some 60 in all, are devoted to his activities: dedication of bat-

tle flags, visit to a state forest, sowing seed, and inspecting a fire tower.

The exploits of the Forest Militia in Ethiopia occupy ten pages, including two colored reproductions of paintings that show black-shirted, brown-shirted, and shirtless forester-warriors in action, literally armed to the teeth. Casualty lists and lists of medals awarded indicate a strenuous campaign.

Among the accomplishments more closely related to our conception of forestry, the captions of the pictures list the afforestation of 210,000 acres of land, improvement of 740,000 acres of deteriorated forest, construction or improvement of approximately 2,000 miles of road and 4,000 miles of trails, 1,260 pasture improvement projects, construction of hundreds of administrative and other buildings in public forests and parks, and numerous erosion and torrent control projects. There are only 667,000 acres of state forest and 430,000 acres of national parks in Italy, but much of the work is done on other land.

W. N. Sparhawk.

Der Wald in Japan (Forest of Japan). By T. Uemura. *10 pp., map. Pub. by Author (?). 1937.*

Japan, one of the most densely populated countries, is claimed by the author to be the greatest wood-consuming country in the world. He overlooked Russia and the United States. Since the World War, Japan has changed from a wood-exporting to a wood-importing country, with net imports of almost 60 million cubic feet of timber and 270,000 tons of pulp in 1935. The pulp, paper, and rayon industries are growing rapidly—Japan led the world in rayon output in 1937—and are increasingly dependent on imported wood.

This brief summary, largely in tables, shows the extent, ownership, composition, and economic importance of the forests, the stand of timber, and the production, consumption, and trade in wood. The total stand of 88.5 billion cubic feet is almost equally divided between hardwoods and conifers. Half of it is in Japan proper. In Japan proper (excluding Formosa, Korea, Hokkaido, and Sakhalin) the annual cut is about 4 per cent of the stand, ranging from 6.4 per cent in private forests to 1.4 per cent in state forests, and the average area planted annually (1930-1934) is approximately 250,000 acres. About 450,000 acres is restocked naturally each year. Figures for the outlying territories are not given.

W. N. Sparhawk.

Pine Nutrition. An Account of Investigations and Experiments in Connection with the Growth of Exotic Conifers in Western Australian Plantations. By S. L. Kessell and T. N. Stoate. *Western Australia Forests Dept. Bull. 50. 45 pp., 8 figs. 1938.*

During the 20 years of its existence the Forests Department of Western Australia has directed most of its effort toward the protection and restoration of the native hardwood forests. However, the establishment of pine plantations has also received considerable attention. Within the past 15 years the government, in order to provide for local needs of softwood timber, has planted more than 11,000 acres chiefly with *Pinus radiata* and *P. pinaster*. Most of these plantations have shown uniformly rapid growth. In the southwestern part of the region *P. radiata* plantations on the best sites have reached a height of 100 feet in 15 years. In some plantations spaced 8 by 8 feet, volumes up to 7,500 cubic feet per acre have been found for the same period.

On certain areas, however, irregular and abnormal growth such as rosetting, yellowing, dead top, thin crown, die-back

tumn brown-top, and needle fusion have veloped. The present study, directed ward working out remedies and avoiding anting on unfavorable sites, attempts to termine the factors affecting the growth pines in plantations. This publication a progress report on this study.

Detailed soil studies were made of the pth, physical properties, moisture re-ining capacity, and of phosphorus, nitro-n, potassium, and calcium content and I. Of these factors, P_2O_5 content was und to be a valuable indicator of the itability of a soil for the two pines xcept soils that have been intensively opped or pastured.) The reaction of *P. diata* to phosphorus differed from that *P. pinaster*. For example, on the best es *P. radiata* grew normally when the O_5 content of surface and subsurface ils exceeded 400 parts per million; *P. naster* when P_2O_5 exceeded 150 p.p.m. poorest sites *P. radiata* did poorly ien the P_2O_5 content was less than 150 p.m. and *P. pinaster* was stunted when O_5 was below 20 p.p.m.

The authors recognize, of course, that e existence of this relationship in west-n Australia does not necessarily indicate nilar relationships in other countries. udies in America have failed to show ch clear-cut differences.

These studies indicate certain practical medial measures involving, among oth-s, cultivation and, where soil analyses ow the need, fertilizing with super-osphate. These conclusions should be interest to American foresters con-onted with problems of poor growth and normal development of plantations such are found in some of our eastern areas. Of special interest is the authors' ob-rvation that the erroneous belief, in istralia, that the demands of certain nes could be met by the poorest of ils, has resulted in unsatisfactory plan-ions on coastal sands which were use-s for any other purpose. Planting men n probably point to similar experiences in this country. This should serve to emphasize the need for careful study of site-species relationships here, regardless of whether the purpose of planting is timber production or watershed protection.

M. A. Huberman,
U. S. Forest Service.

A Leaf Key to Florida Broad-Leaved Trees Native and Exotic, Except Palms. By Mary Franklin Barrett. *79 pp. Illus. Pub. by Author, 57 Union St., Montclair, N. J. 1937. Price $1.*

This outdoor key to 620 species of native and introduced trees of Florida is based on leaf, twig, and trunk characters, and is therefore far more useful to the layman than if it depended upon flower morphology. A tree is considered to be "a woody plant with a single stem (trunk) at least three feet tall before it branches, and with a mature height of at least 10 feet." Palms, conifers, and unusual broad-leaved trees found only in nurseries, introduction gardens, and private collections are not included; notwithstanding, a surprising number of rather rare exotics are keyed.

The system is dichotomous. The general key is followed by a series of subkeys, arranged from A to Y (18 of these have one or more numerical subdivisions) for trees with simple or apparently simple leaves, and from Z to ZZ (without subdivisions) for those with compound leaves. The plan is very ingenious and seems to be entirely workable, even though the grouping of remotely related genera and species in some of the keys is, at first glance, somewhat disturbing to a taxonomist. For example, Key U 2, entitled "Small or shrubby unarmed trees; leaves simple, spiral, pinnately veined, entire, no stipular rings, not aromatic, more than 2 vertical rows, blades to 7 cm. long," keys out 19 species, representing 14 families as

far removed phylogenetically as the Myricaceae from the Ehretiaceae. Two species of oak, *Quercus geminata* [usually not accorded specific rank] and *Q. myrtifolia,* are numbered among these. However, there is a separate key (X 3) elsewhere for the genus *Quercus,* with five subdivisions (X 3a to X 3e inclusive) for the 27 species treated in this pamphlet. A similar plan is followed throughout, as can be seen by consulting the index. The latter, which is in the nature of a check-list, is unusually good; it not only designates the particular key or keys for each species, but also lists valid names with synonymy and common names.

There are 8 plates of 4 to 8 figures each, illustrating various leaf types and their venation. The two and one-half page introduction includes instructions for the use of the key. There is also a list of reference literature and an enumeration of some outstanding collections and introduction gardens, with locations, in Florida.

MIRIAM L. BOMHARD,
U. S. Forest Service.

Forestry Practice: A Summary of Methods of Establishing Forest Nurseries and Plantations with Advice on Other Forestry Questions for Owners and Agents. *Forestry Commission Bull. 14 (Revised). 99 pp. H. M. Stationery Office, London. 1937. 1s 6d.*

Issued originally in 1933, Bulletin 14 so effectively answered the questions of English woodland managers that the first printing was quickly exhausted. The demands continued to such an extent that, with slight revisions, it was again issued in 1937. The only major change is the omission of Part V of the original edition, dealing with conditions of privately owned woodlands. The reason given for leaving out this section is the difficulty of bringing this information up to date; but this is no serious loss.

The most engaging point about both editions is the style of writing. It is almost conversational in tone, and for this reason the popularity of the publication is readily understood. This tone may have been overdone by the authors in several instances, as for example, "It cannot be too definitely borne in mind that a forest tree seedling is a delicate and tender plant which is only happy if its roots are warmly tucked up in a bed." But these may be forgiven in the interest of simplification.

The authors helpfully summarize the details of the growing of seedlings and transplants, site preparation, planting, early treatment such as weedings, thinnings, and prunings, and the protection of plantations which are, for the most part, similar to American practice.

Planting men in this country will be interested in the following statement: "On most private estates too much trouble is taken in planting to secure 100 per cent survival. It is a luxury which is apt to be very expensive. . . . Any one in charge of planting should therefore be quite content if, say, nine out of ten plants survive, and should not bother to replace the dead ones unless they occur in definite groups." It is interesting to compare this with the belief of some in this country that 250 surviving trees out of 1,000 or more planted per acre represents an "established plantation."

Also included are sections on markets, costs of nursery and plantation phases, and other financial aspects. Because of the consideration being given to plans for cooperation with farmers and other woodland owners in this country, foresters will be especially interested in the last section of the bulletin "Forestry and the State. Income Tax, Death Duties, and Grants."

The British government grants up to £2 an acre for conifers planted and thenceforth maintained as a forest crop

d from £2 to £4 for hardwoods—de-nding on the species. The grants are stricted to projects involving not less an 5 acres. When the season's work s been satisfactorily completed and in-ected, three-fourths of the grant is paid. e balance is paid 4 years later if the cessary "beating-up" (replanting of fail-ots), has been done and the plantation tisfactorily established and maintained. 'erhaps these provisions, published in e original 1933 edition, are the basis r labeling New Deal policies for farmer sistance as "un-American.") the ques-n which comes to mind, however, is hether areas planted under this scheme grants will continue to be conserva-ely managed after the last payment is ade. Those responsible for similar plans this country would do well to keep is question in mind.

M. A. HUBERMAN,
U. S. Forest Service.

oads, Canals and Embankments with Caterpillar Equipment. By F. A. Nikirk. *182 pp. illus. Caterpillar Tractor Co., Peoria, Ill. 50c.*

Compiled by a civil engineer as a com-ehensive guide in road building meth-s and equipment, this book will prove a ndy source of reference for those super-sing the construction and maintenance forest roads. Technicians and foremen C.C.C. camps in particular will find in much valuable information, not only in eir actual construction projects, but also enrollee job-training courses. Tractor erators especially can make good use it. Written in non-technical language, is profusely illustrated with photographs d diagrams.

The book has eleven chapters of which e most useful to the forest worker will those on road construction, road im-ovement, paving and road surfacing, d road maintenance. Especial emphasis is placed on the economic principles involved in the use of construction equipment, and on the application of these principles to designing and laying out work and to the management of engineering construction.

Although the discussion of equipment performance are centered around Caterpillar track-type tractors and road machinery, the book is considerably more than an advertiser's blurb. The engineering procedure outlined appears to be sound.

The present reviewer is informed that the price of the book is just sufficient to cover the actual cost of printing and mailing, and that the edition is a limited one. Copies will be made available to the readers of the JOURNAL OF FORESTRY as long as the supply lasts. Consequently, it will be desirable to mention the JOURNAL when ordering.

HENRY E. CLEPPER.

Deutschlands Holzwirtschaft. (Germany's Wood Industries.) By Johann Albrecht v. Monroy. *Der Vierjahresplan. 2:10-18. Illus. 1937.*

This article deals with the relation of Germany's wood requirements to her wood production and imports. Her total consumption of wood in 1936 was 35 million cu. m. for firewood and 46 million cu. m. for all other purposes. The production of wood, exclusive of firewood, was 35 million cu. m., which is 33 per cent above normal. Between the 46 million cu. m. of wood used for constructive and industrial purposes and an estimated possible continuous production of 27 million cu. m., there is a gap of 19 million cu. m. which at present is supplied by imports but which it is believed can be reduced by improvements in growing timber and better utilization. On the other hand, consumption may increase by 3 million cu. m. in 1940, particularly for fiber and

chemical products, making the total deficit 22 million cu. m. This deficit is to be made up as follows:

	Million cu. m.
Use of firewood for conversion products	9.0
Use of industrial waste wood	5.0
Use of woods waste	0.5
Use of orchard, street, and park trees	0.5
Imports	7.0
	22.0

Greater economy in the use of timber is to be sought through better preservation against decay, use of no more wood than is necessary according to best construction principles, use of new methods of construction, greater use of pressed board made from waste, and increased use of veneer and plywood. Economy in fuel wood may be accomplished by using more efficient combustion equipment. (The use of wood for power gas generators is declining because it is cheaper to use gasoline made from coal.)

To meet the expanding needs of the cellulose and fiber industries the author proposes the increased use of spruce of firewood grades, larger use of beech and pine, and more extensive use of straw and old paper.

The use of hardwoods in place of conifers wherever possible is recommended, since Germany's production of conifer to hardwood industrial timber is in the ratio of 6:1 whereas the ratio for consumption is as 10:1.

No restriction in the use of wood is proposed, only efficient utilization, except that coal be used for fuel in place of wood wherever costs permit.

It is interesting to note that whether a nation's wood supply is a drug on the market as it was a number of years ago when cheap imports were dumped on Germany's shores and questions of finding uses for native timber, especially low grades, became paramount, or whether the supply is not large enough to meet the nation's requirements, the problems of utilization stand out as the keystone in the nation's forestry policy.

In summing up, the author points o that no discussion of Germany's fore products requirements is complete witho reference to the importance of regaini possession of colonial forests, especial in view of the rapid growth and hig yield of tropical forests. The supporti statement is weak, however, in that compares Germany with her 12.7 millio hectares of forest land and no colonie to England with 1.2 million hectares home forest land and 700 million hectar of colonial forests and France with 10 million hectares of forest land at hom and 141 million hectares in her coloni without reference to the requirements the population in those countries and pa ticularly within the colonies or dominio themselves.

ARTHUR KOEHLER,
U. S. Forest Products Laboratory.

Florida Wild Flowers. An Introdu tion to the Florida Flora. By Ma Francis Baker. *New ed. 245 p Illus. The Macmillan Company, N York. 1938. $3.50.*

Books such as this dealing with the w flowers of a particular state always ha popular appeal and are, on the who very useful. This one describes 8 species of flowering plants growing Florida and contains much interesti information, including distribution a time of flowering. There are 49 pho graphs, most of them excellent, of ca fully chosen representative plants. T new edition is improved over the fi edition (1926) in its more attractive co position and the addition of 15 pho graphs and more than 150 new spec diagnoses.

A general artificial key for identifi tion of the plants is based first on flo color and then is subdivided according herbaceous or woody type, kind and rangement of leaves, flower details,

genera of certain larger families are keyed in the text. Informal discussions of each plant family are usually followed by generic notes. Over 650 species diagnoses of several lines each set off in small print. These are too brief. This is particularly true of the composites, a very difficult group at best, where terse descriptions are furnished for species (only 6 are illustrated), following a key. If there were only 94 species of composites in Florida, this would be useful; as it is, the descriptions much too condensed to be very helpful in identifying random plants of this family.

From a scientific standpoint, it is disappointing to find that the new edition is more thoroughly revised as to botanical accuracy. For example, the very same sketchy and incomplete diagrams of flower parts are reproduced (p. 6). A statement, triply questionable botanically, again appears in the new edition to explain parts of a flower; *viz.*, "The different parts of a flower are in concentric circles around the all-important seed-vessel the center, which has one or more pistils." The carpel, pistil, and "seed-vessel" not clearly defined. The terms, "pinnate" and dipinnate," are explained under compound leaves, but "palmate" is omitted. The layman so often mistakes a leaflet of a compound leaf for a complete leaf; yet, in this book of popular character no hint is given that the bud in the axil of a true leaf, whether simple or compound, neatly settles the whole matter.

Many of the family treatises could have been made more clear. To mention but one instance, under the heading Beech family (p. 62), is the Latin family name, Fagaceae, and then the brief characterization: "Trees, shrubs. Leaves alternate. Flowers minute. Fruit an acorn." This is followed by a discussion of oaks (Genus, *Quercus*). The average reader has no way of knowing why the Fagaceae is called the Beech family and concerns only plants with acorns. Beech (*Fagus*) and chinquapins (*Castanea*) of this family do not have acorns, but they are represented in the Florida flora; no mention is made of them.

The inclusion of a species of water-hemlock, *Cicuta curtisii,* could not have been because of the beauty of the flowers; yet, nothing is said as to the poisonous character of this genus or of any of the other Umbelliferae.

In view of the mass of splendid information in this work and the wide circulation it enjoys, it is unfortunate that simple botanical facts have not received more thoughtful consideration.

MIRIAM L. BOMHARD,
U. S. Forest Service.

CORRESPONDENCE

Dear Dr. Schmitz:

I feel discomfited and somewhat aggrieved that Dr. Boyce's review of C. P. Ackers' book, *Practical British Forestry*, appears in the May Journal. I have profound regard for Dr. Boyce, but feel that in this instance he has failed to do justice to a significant work, and that he has given it a very decent and unmerited burial in the mass of forestry literature. He does not point out that Mr. Ackers draws his illustrations not only from the United States and Canada (32 pages to our species and management in one place, and frequent reference elsewhere), but also from South Africa, India, Australia, the several European countries, especially Sweden, all of which he has visited personally, and some of the places in Europe a number of times. The book has worldwide significance wherever English is spoken.

In addition to the nurseries and sawmill on Mr. Ackers' estate, which Dr. Boyce mentions, he has a wood preservation plant, and discusses it in a telling way for all foresters. For thirty-five years he has *had to make forestry pay*, has made his living from it. His point of view is, therefore, remarkably practical. For instance, a sawmill plant may be quite too elaborate and expensive. The book is particularly rich in discussing introduced American species, particularly from the Pacific Coast, because English soil and climate are somewhat similar.

Dr. Boyce says that the book can be read with profit by any forester. As I see it, the book *should be read by all foresters*, for to my thinking, it is the best book extant in silvicultural and forest management. Forty years ago, I took Dr. Fernow's courses covering this field. He knew European practice thoroughly and had unrivaled opportunity (the be[st] at that time) to know American conditions. From that time to this, with the exception of Austin Cary's work, which covered American observation only, no book comparable to that of Mr. Ackers has been written as far as I know. I feel that it is epoch making in its field. Perhaps you have seen Mr. Hiley's laudatory review in the current *Quarterly Journal of Forestry*, to which Barrington Moore calls my attention.

If the matter is left where it is, I shall feel that American foresters have not been made sufficiently acquainted with a work of great value to them.

I do not write because I care a f[ig] whether my review goes into the Journal or not, but merely in what seems to m[e] justice to Mr. Ackers, and to American foresters generally.

Philip W. Ayres,
New York City.

Dear Dr. Schmitz:

Referring to the letter of Michael P[o]chan, Jr., in the May issue.

Mr. Pochan and others are learning that the law of supply and demand controls jobs as well as cotton and wheat. Following the trend of the times they holler for somebody (Korstian and the Society) to do something (get them [a] job) *right now*. The letter ends with so[rt] of a threat, "Remember that you are working with disillusioned youths and their careers."

That at least is a hopeful sign. Th[e]

disillusioned. In other words they e waked up. Their dreaming through years of college life with the happy ectation of being handed, upon awak- g, a position paying $2,000 a year been rudely ended. They learn that competition and individualism still ts in these United States.

owever, this inability to find work in r profession upon graduation is to be ored. Something we all regret. What or help can be offered?

ochan seems to think that the profes- holds the answer. The heads of for- y schools should discourage enroll- t. They should shake their heads y and say dolefully, "We cannot rec- nend that you study forestry. We do know where you would get work. We bably will not be here very long, our- es." The Society should publish a thly calamity list showing the number rofessional jobs that have been abol- d. It might go still further and issue phlets showing the inducements and ntages of other professions. Any such posed action is ludicrous.

there any profession, trade or voca- that is not overcrowded. Many square get or attempt to get into every pro- on. Having a large number of ap- nts from which to choose keeps a ession strong and healthy for the men interested and who show the most ude. The best men eventually get a hold and make good; the weaker ones nto other work which in the end is r both for the men themselves and he profession.

here are many things which a forester out of school should consider these . If he cannot get a job, what is the on? There are a certain number of rring vacancies in forestry work ugh resignations, promotions, retire- , and death. Why does not the young ter get some of these vacancies? Per- the trouble is with him as an indi- al. How well prepared is he? Four years of college is small preparation for any profession. What is his age? Many men with bachelor's degrees are often only 21 or 22 years of age. How much does a young man of this age know of practical work—not only of his profession but of any work? Has he the physique necessary for hard out-of-door work?

Assuming that his failure to get work is not due to himself, that he has had at least five years of university training, is 24 or 25 years of age, is husky and in good health, has been around and has done some actual work—what then? Government positions, except for replacements seem to have reached the saturation point. If this man is bound and determined to be a forester it is up to him to widen the field; to expand the market. He has something to sell. He must find a buyer.

As I look at it there are three possible outlets for more foresters: in the wood using industries, on private estates, and singly or in groups, taking over a forested area and making a living on it either as operators or as timber planters. Every timbered tract of 10,000 acres or more, every city of 20,000 population or greater, offers potential employment to a forester.

This extension of the field of forestry should be one of the major objectives of the Society. No doubt some action along these lines is being taken but a definite program should be made for this purpose and a vigorous campaign inaugurated.

Indications show that wood working industries are turning more and more to forestry practices. How will "disillusioned youth" meet this situation? Will they sit down waiting for an "appointment" to a $2,000 a year government job and allow a punk who can pull a whistle cord or run a compass at $100 per month become the company "forester" in a few years at $1,800 per year or more, or will they get out at wages, learn to swing a

double-bit axe, meet competition shoulder to shoulder, and take a chance that the best man may win?

In my opinion and from my limited observation there have been too many foresters, illy prepared through scanty education and inexperience and spoiled during the last few years by high salaries they were not worth. Young foresters, particularly if they wish to work for private concerns must be ready to work for wages or for low salaries until they can get a start. It will be tough for awhile but the final outcome is limited only by a man's ability. Doctors, engineers of all kinds, commercial and industrial men put in this apprenticeship. Foresters also must be prepared to do it.

Heretofore forestry has been too easy to get into. This possibly had a tendency to make many of those now in it—some of whom could probably never have made the grade under the present stiff competition—smug and self satisfied but I believe that all who are on the inside will help the newcomers whenever possible. At present the staff of most industrial foresters is nil. He is his own junior forester and office boy. There is no opportunity for him to hire foresters but most of them will aid a young fellow forester looking for a wage job. But don't write—ask. No foreman wants a pig in a poke.

Disillusioned? Keep your chin up and use your head.

Arthur D. Read,
Alexandria, La.

Dear Dr. Schmitz:

I was very much interested in the articles by Messrs. W. E. Bond, N. D. Canterbury, G. H. Lentz, and Matt Rue, which appeared in the June issue of the Journal, as I have been in very close contact with the conservation program initiated last year by the pulpwood industry in th South.

It seemed to me that Mr. Canterbury article left the impression that industr turned thumbs down on the rules an regulations drafted as suggestions by th U. S. Forest Service without giving du consideration to their value. This was n the case, and I should like to correct an such impression that may exist.

In drafting their set of rules, the Fore Service apparently overlooked the fa that such rules of forest practice we principally intended, under the progra in question, not for the lands belongi to industry, but to be applied on t forest lands in outside ownership fro which the industry procured its pulpwo As a general rule the areas involved such outside ownership are small, elimi nating any possibility of operating eco nomically on a sustained yield basis separate units. In addition, the indust recognized the difficulties involved in p suading the owners of small forest-la areas to practice any complicated syst of forest rules or to adopt any metho of operation which would reduce to a great extent the immediate maximum p ceeds available from the sale of th standing timber.

It was quite natural and in order the Forest Service to propose, as a poi from which to start the discussion, su rules as would give the maximum th retical results in reforesting and build up growing stock; but the industry, aft taking all questions into consideration a from experience with the smaller la owners over many years, chose the si plest type of rules, recognized as falli far short of requirements—if building of growing stock was the principal ob tive—but which served the purpose preventing denudation and assured re estation for the future. This did not m that industry turned its back on the po bilities of better methods, immediately some cases and eventually in others,

vas felt that such a program could not successfully carried out by utilizing most advanced ideas at once. Forest d owners must learn that good forest ctices are possible and profitable be- e perfection can be attempted.

)ne other point impresses itself upon when I note the many articles on good est practices which are published, and isider the time and thought which go ɔ their preparation. Such articles are uable, without question, and contain ny excellent suggestions which will no ıbt prove extremely beneficial to forest ds if put into practice.

Iowever, when one glances at such ures as Mr. A. E. Wackerman provides a recent pamphlet, showing that forest ıin from fire in the Southeast was a at deal heavier than the drain from all est industries combined, it seems that least some of the thought expended on ɔd operating methods might profitably turned to methods of preventing such ıual destruction of timber. Such time and thought might be directed not only toward ways and means of preventing and suppressing fires, but also toward devising laws and methods of enforcing laws which would prevent incendiary fires; for the largest percentage of fires in the South are not accidental but premeditated. More time, more publicity and more pressure should be used in obtaining needful appropriations for fire prevention. Congress would not ignore the pleas for adequate appropriations for fire prevention if the requests of the Forest Service, state foresters and a few others could be swelled to a general demand from all the people "back home".

This is not to be construed as any criticism of thoughtful articles and advice on operating methods, but I am afraid we are placing too much stress on this phase of conservation while fire wipes out the forests on lands on which these methods should be practiced.

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